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RESEARCH ARTICLE

Envisioning the Future – A Question of Distances

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Abstract

In this paper we will examine how children view their future. Intergenerational relations are at the core of sustainable development. These concern a human's moral responsibility to the coming generations. But, can we take for granted that future generations will have the same requirements and preferences as we do? Discussions of the future often take off from an adult perspective, but what would the visions of the future be, if children were asked? Theoretically the study is based on the life-world phenomenology. Our study was conducted in northern Sweden in 2011. Altogether, 22 children aged 11 to 12 years participated. They were asked to make a drawing to answer a question 'what does the future look like when you are grown up?' During the analysis, four themes emerged; *technology, career, apocalypse and sameness.* According to our results, we consider that there is an aspect of *distance* imbedded within the visions.

Keywords**:** children's visions, future, education for sustainable development, intergenerational relations, phenomenology

Introduction

What are the visions of the future that children have today? This paper provides a perspective on how young people imagine their future based on their lived experiences. Our aim is to illuminate and discuss the future from a child's perspective in the framework of education for sustainable development (ESD). School is one of the places where visions of the future are formed and challenged. Education plays a key role in societies striving for long-term sustainability. The general goal of sustainable development (SD) is "to meet the needs of the present without compromising the ability of future generations to meet their own needs", as stated in the Brundtland Commission's report *Our Common Future* (WCED, 1987, p. 43). Through a study among children at grade 6 in an ordinary elementary school in northern Sweden, we will examine how children view their future. This study is based on children's drawings and their oral and written comments in relation to these drawings.

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In environmental politics in general, *The Limits to Growth* from the Club of Rome in 1972 was the start of taking into account future generations (see Meadows, Randers & Meadows, 2005), but it was the Brundtland Commission's report (WCED, 1987) that made a breakthrough with new temporal ideas in environmental education. The report introduced a new aspect in the debate on environmental education – the time perspective. As a consequence, the demand for ethical responsibility towards the coming generations was made explicit.

Sometimes it is said that teaching has changed from what used to be called environmental education (EE) to what is now called education for sustainable development (ESD). When such a distinction is made, ESD offers a more holistic approach, where ecological, economic and social aspects should be integrated with each other. Issues of SD pose important questions for the future of human society as well as for those who wish to teach for a just and sustainable future (Fien, 1995; Breiting & Wickenberg, 2010). There is criticism that EE and ESD have both been, and still are, focused too much on problems and pessimistic views of the future. There is a danger that this will reduce children's confidence in being able to make a difference (Lidstone & Stoltman, 2007; Jonsson, Sarri & Alerby 2012). On the other hand, Ojala (2007) claims that young people's worries concerning the environment can have a positive impact, such as motivation to act in a pro-environmental fashion (see also Persson, Lundegård & Wickman, 2011).

Our point of view is that aspects of the future within ESD need to be discussed more thoroughly than it has been done so far. In previous studies in ESD, for example, Hicks and Holden (2007) argue that the temporal dimension is of paramount importance in ESD. They emphasize that ESD is implicitly involved with probable and preferable futures. They also argue that young people need guidance to think more, rather than less, critically and creatively about the future, whether from a personal, local or global perspective. Also, Hutchinson (1997) emphasizes the future dimension in education, suggesting that environmental educators need to listen actively to what children say about the environment and the future, and to deal with their concerns with honesty and care. The emphasis has too often been on the past and present, and rarely from a child's perspective. The importance of listening to children thus needs to be highlighted. The most obvious reason for is that all teaching should begin from the learners' pre-understanding. In other words, it should start in the life-world of children (Jonsson, Sarri & Alerby, 2012; Hertting & Alerby, 2009; Alerby, 1998).

Visions of the future have been studied in the school context in different ways. Gidley (1998) looks at Years 10–12 students' sense of empowerment with regard to their view of the future. Eckersley (1999) suggests that the gap between the ideal and real futures of young people is getting wider. Further, he says that pessimism about the future reflects real concerns, but also the failure of people's vision of the future as a source of inspiration for both individuals and society. Tsevreni (2011) has studied children's perspectives on the future in relation to their action competences. Connell et al. (1999) looked at the hopes and fears about the future among Australian young people and found that they were concerned primarily with personal futures – personal relationships, careers, academic success and enjoyment. Jonsson, Alerby and Sarri (2012) studied Sámi children's vision of future from a cultural perspective. They discuss the tension between the Sámi culture and that of western modernity and how different themes, such as the economy and environmental change, will have an impact on their culture and way of living in future.

Intergenerational relations are at the core of SD (Barry, 1999). These concern a human's moral responsibilities to the coming generations with regard to attitudes about and behaviour towards the environment (Tuncay, Yilmaz-Tuzun & Tuncer-Teksoz, 2011). Looking

at intergenerational relations towards the future at a deeper level, we find that some problems are embedded in the task. For instance, can we take for granted that future generations will have the same requirements and preferences as we do? Let's take an example: if SD had been on the agenda 2000 years ago, we would probably not have been allowed to cut down the beech forest that covered southern Europe, or be able to enjoy a glass of wine under the olive trees. As Karlsson (2005) points out, the present demand for a good life – in terms of food, possessions and services – looks totally different from what someone in a pre-modern context would have expected. He argues that science changes our demands and, more importantly, it changes what is possible to think. We may have a common idea of the challenges and threats we face, but we are not as agreed about what we want the future to be. Overall, SD is a quest for values on a specific time-horizon (see Lundegård, 2007, 14)

Intergenerational relations have been a focus in several studies. Almers (2009), for example, seeks to tackle the question of intergenerational responsibility with regard to the distance moral approach. This explains moral responsibility in relation to people whom one does not have direct contact with because, for example, one does not live at the same time as them (Almers & Wickenberg, 2008). They assume that it is the distance moral dimension in action both spatially, but above all temporally, that is the specific political novelty in the fundamental value of SD. Prout (2011) suggests that it is important to keep the generational relations open-ended, which means that multiple generational ordering would be possible. This means that instead of taking for granted what the intergenerational relations are and what they mean; we should explore the values and complexity embedded in these relations.

Intergenerational relations can be understood through the concept of temporality. Temporality can be seen as a description of different qualities of time (see Adam, 1998; Held, 2001). Adam states that the industrial way of living is influenced by an invisible rhythmicity and pace of ecosystems. 'Invisibility' in this context refers to features of living that we are unable to see, hear, taste, touch or smell. SD is an inherently temporal concept, thus Held argues that it needs temporal diversity to be taken as its starting point. We improve our understanding of SD if we explicitly start from a temporal perspective.

Theoretical and methodological framework

Our study of children's views of the future relies on the phenomenological philosophy of the life-world, which was originally an attempt to understand how humans relate to and interact with the world. It is a philosophy of experiences that is characterized by openness, sensitivity and flexibility towards things (Husserl, 1970). A phenomenological understanding of 'being-in-the-world' is the point of departure in our study. As we look at the temporality of children's visions, we relate to Merleau-Ponty's claim (1962, 279) that the body takes possession of time – it brings the past and the future to the present. He argues that "the life of consciousness – cognitive life, the life of desire or perceptual life – is subtended by an 'intentional arc' which projects round our past, our future, our human settings, our physical, ideological and moral situations, or rather which results in our being situated in all these respects" (ibid, 136). In addition, he describes that one acts in the world through the body, and that space and time are indeterminate horizons that the body inhabits.

Studying experiences always requires interpretation at several levels. van Manen (1990) argues that reflection on lived experiences is always recollected – it is a reflection on experience that is already passed or lived through. In the same way, when children formulate their visions of the future, they do so based on their lived experiences. In other words, children's future expectations are bound to the life-world that they live in. According to van Manen, basic things about our life-world, such as our experience of lived time, lived

space, lived body and lived human relations are preverbal and are therefore hard to describe. Orientation to the temporality is to consider experience of lived time in a more explicit way. The richness of our visions emanate from the richness of our experience of the life-world. Thereby visions need to be described as they exist.

Sample

Our study was conducted in northern Sweden in the spring of 2011. Altogether, 22 children aged 11 to 12 years participated. They were asked to make a drawing to answer the question 'What does the future look like when you are grown up?' The data was collected during one lesson including time for drawing and discussions with each child. We emphasized that it was not a task to determine how skilful they were in drawing; instead, we wanted to know what kind of visions, images, thoughts and feelings they had about the future. We asked them to reflect on the question individually and to make a drawing of their reflections. When they had finished, the children were asked, one by one, to comment briefly on their drawing. This happened in the end of the lessons in the separate room to secure privacy for reflections. We posed questions that related to the meaning or purpose of the drawing. For example: 'What were you thinking when you were doing this drawing?´ All 22 children made both drawings and talked with us about those. Some children even wrote comments on the drawing at the same time as they were doing it. According to Einarsdottir et al. (2009), asking children to reflect on their experiences is an activity that demonstrates children's competence as communicators and as people capable of reflection on what is meaningful to them. She also points out that the combination of drawing and telling enables reflection on several aspects of phenomenon in question, e.g. future visions (see also Alerby, 2000; Alerby, 2003).

Method

Children's drawings have been used before as a method to get closer to their life experiences (see also Alerby, 1998; Hertting & Alerby, 2009; Fleer, 2002; Jonsson, Alerby, & Svonni, 2012). According to Dewey (1991), language includes much more than oral and written speech – for example, paintings and other pictures. As he expresses, "anything consciously employed as a *sign* is, logically, language" (p. 170). Alerby (1998; 2000; 2003) also suggests that drawings are comparable with any other form of communication and notes that an understanding of a drawing requires interaction between the person who has made the picture and the one interpreting it. Furthermore, she argues that using drawings opens up the possibility of explaining associations more openly than is possible with other forms of expression.

The analysis

Alerby (1998) and Dahlberg et al. (2008) claim that attempts to 'see the invisible' are part of the analysis. It is not enough to describe what is in a drawing: the phenomenon that it is expressing needs to be understood. In a phenomenological study, the result can be captured and described as in terms of different themes. During our analysis, drawings and a transcription of oral comments were viewed as a unit, and qualitative similarities and differences were noted. Differences in expression and meaning helped us to determine the themes that we would use. It is important to note, however, that the themes are not intended to be clearly distinct categories (van Manen, 1990), nor are they quantifiable features – different themes can overlap and connect to each other. Essentially, the themes are analytical tools to describe parts of people's experiences regarding the phenomenon that is under investigation. In the analysis, we tried to reach the meaning embedded in the drawings and sometimes it was the children's oral or written comments that made the difference.

Results

After viewing all of the empirical material together, we were able to identify some similarities and differences at a thematic level. Four themes were crystallized: *technology for the future, making a career and envisioning a working life, when the world goes under – apocalypse* and *it will be good anyway – sameness*. We will now look more closely at each of these themes.

Technology for the future

Characteristic of the theme of technology was to describe some change in a society based on a technological innovation that does not yet fully exist – for example, "the new generation's cars" and portable houses. Technological objects were situated mostly in public places, like cities or in traffic. In some sense, this theme is an optimistic vision of solving the risks and threats of the future using advanced technological innovations.

These visions may be answers to the question 'What will it be like in society in the future?' Some of the technological solutions were motivated by environmental arguments. For example, one child argued: "We are going to have electric cars instead of gasoline cars. Perhaps it is going to be some new invention like a flowing car that is not so bad for the environment" (Figure 1). Another drawing (Figure 2) expressed a society built on the moon. This child explained that he believes that people will be able to live on the moon in the same way as they do on the earth. The moon will just be an alternative environment to live in –he didn't believe that the society or culture would be any different. He said: "People go to the moon just because it is possible. I wouldn't want to live there but perhaps I could visit it." He also explained that the person in his drawing is not him but another child playing football.

Figure 1. Flowing cars, portable houses and possibilities for teleportation. Translation of the text in a drawing: Flowing cars and houses that can be moved. There is a tent and a footpath as well as flowing shoes. Teleportation is very expensive.

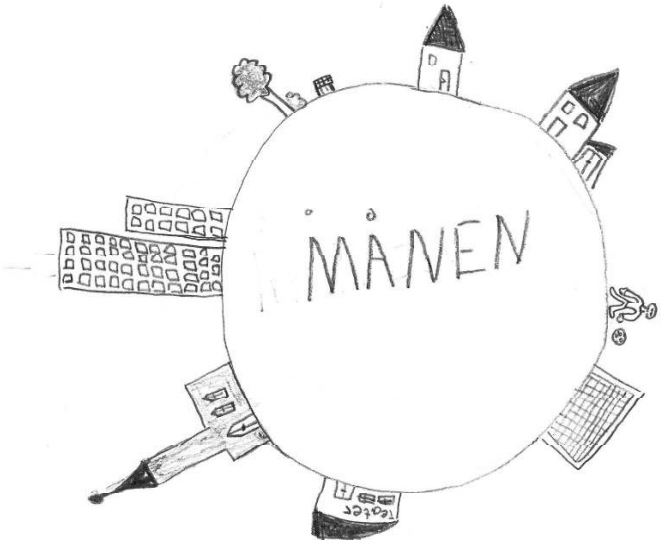

Figure 2. A similar society built on the moon. Translation: Månen = the moon

Within the theme of technology, the children expressed a spatial and/or temporal distance from the things they draw. They explained that the situation in a particular drawing would happen to other people in some other place. Their visions also expressed a moral distance between humans and nature, which could appear to be indicating a control over nature by humans (Figure 2). Signs of familiar socio-cultural structures – such as theatres and churches – as in the drawing of the moon, highlighted the link between children's lived experiences and their visions. Within this theme, the children envisioned a future that would look different from the present as a result of human scientific and technological innovations, as well as our need to develop and expand our living space. A more individual or personal approach to the future can be found in the next theme.

Making a career and envisioning a working life

This theme is characterized by an individual framework in which children could be answering the question 'What is going to happen to me in the future?' (Rather than 'What is going to happen around me in the future?' as in the previous theme). Work and hobbies played a central role and personal success very often featured. Most drawings presented just one person and individual activities were placed the centre. In one drawing, a child drew himself as a critic and explained: "I want to become a critic and I want to read what other people have written. I will work at home with my computer" (Figure 3). However, some of the children saw themselves as part of a wider, global context (Figure 4). For example, one child explained: "I want to work in the hospital, in the X-ray department. I want to find a new cure to diseases." This hope for scientific solutions to the threats of diseases is similar to the theme of technology. However, in contrast, here a child often featured in their own drawing to illustrate their career and working life. The visions were often close to the children's life experiences such as where a boy drew himself sitting and reading in his own room (Figure 4). This is an expression of the narrow spatial and temporal distance that he has

experienced. The next theme illuminates visions that have little personal or individual framework. It expresses an apocalypse of the world and has a framework of long distance in all respect: spatial, temporal and moral.

Figure 3. A nurse on the way to work at a hospital. Translation: Sjukhus = a hospital, Akut = Emergency room

Figure 4. Home as a workplace.

When the world goes under – apocalypse

Sometimes, children's visions of the future expressed concerns about environmental catastrophes and war. Their drawings could be an answer to the question "What is the worst thing that can happen to the world in the future?" The degree of distance in these visions was wide-ranging with regard to the moral, temporal and spatial dimension. One child believes that people are going to cut down all trees, which will cause environmental disasters and finally the end of the mankind (Figure 5). Others expressed visions of terror, war and overwhelming industrial pollution (Figures 6 & 7). One child explained: "It is going to get worse. There are wars of oil. The only thing people can do is to close the factories. There is nothing that I can do. It is just the big companies that can do something. The situation is getting worse all the time and there will be a lack of clean water as well." When children focused on all of these threats, they expressed very pessimistic views and described the apocalypse. For example, one child (Figure 7) draws a polluting industry, destroyed forests and war. This drawing is set far into the future, in the year 3049, and the child has written on it that afterwards the world is going to end.

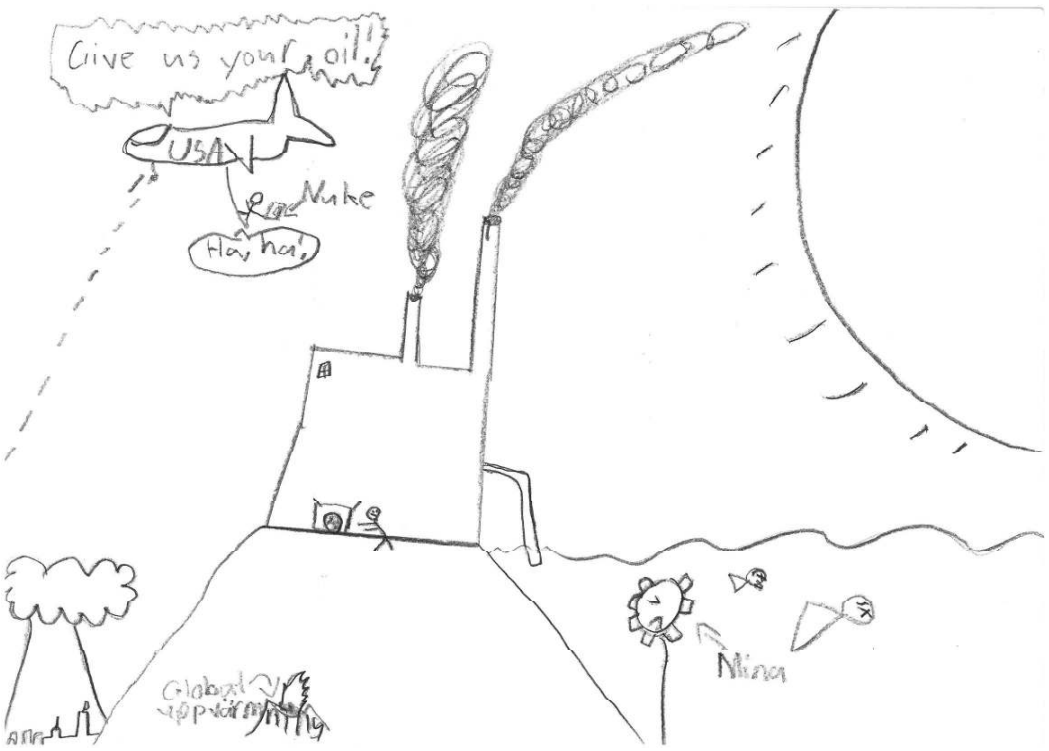

Figure 5. War of oil, industrial pollution, nuclear power and mines causing trouble. Translations: Global uppvärmning = global warming, Mina = a mine

Figure 6. From good environment to bad environment, chaos and the end of the world. Translation: Environment. All the trees will be cut down and it will be chaos in the environment and finally the world goes under.

Figure 7. The year 3049 and the world is heading towards its end. Translation: år = yaer, Senare jorden går under = Later the world goes under.

The underlying threats seen to be leading to the apocalypse are both social and environmental. The catastrophe may depend on conflicts between humans or between us and nature (forest, water and air). In Figure 6 the child describes a war of oil and has written: "Give us your oil!" This shows an issue of conflicting human interests concerning natural resources. The framework of these drawings is global because the development of various problems is leading to the total disaster of the earth instead of just some part of it. In

contrast with the theme of technology, scientific and technological development would not rescue humans in the visions of an apocalypse.

We can reflect on what ways these visions relate to the life-world of these children. The children's cultural knowledge is probably the key issue here. Myths of apocalypse have been a part of western culture that goes way back in history and are still a part of many cultural forms, such as literature, music, film and games (see Hansson, 2010). According to Håkansson (2010), there is even a risk that schools are contributing to apocalyptical visions of the future. He claims that education of the climate change can in the worst case result with the negative visions of the future and low political engagement. Another approach to the future is to emphasise stillness or sameness – a world that will not change, as follows.

It will be good anyway – sameness

Sometimes children didn't express any differences in ways of living or in the surrounding world compared with the present situation. Uncertainty about the future is obvious within this theme. Children's capability to reflect the future is weak when they don`t express any moral, spatial or temporal distance. One child wrote on the back of a drawing: "I think that my future will be easy. I mean not mentally, that will be hard. But to live in an ordinary apartment, working in a boring ordinary job, have kids. But I don't know if I want it to be that way. I want to live in a house, work with something that I like, travel a lot and have kids. All in all, it will be good anyway☺" (Figure 8). According to this, the idea of becoming a grown-up can feel confusing. Even though it is not clear what will happen in the future, this child is optimistic that things will turn out fine.

Children's visions of the future were sometimes emotional. Due to this they found it hard to describe them through activities or objects, as in previous themes. Feelings of anticipation about the future may focus on the psychosocial elements of life, which are hard to describe either visually or verbally. One child, however, drew apartment blocks that reminded him of the buildings beside the school (Figure 9). He explained that the future would 'look like the usual". The sameness of his versions of the present and the future might be an expression of the difficulty he found in expressing temporal distances.

Figure 8. Two apartment houses and a sunny day.

Figure 9. A person walking on the street and an airplane has just taken off.

Discussion and conclusion

What do children's visions of the future tell us? By studying individual visions of the future, we increase the understanding of what issues children consider worth taking care of. By illuminating the richness of children's visions it is made clear that their experiences are both unique and part of the shared life-world. Based on the results of our study, we consider that within the four themes there is an embedded aspect of distance. By 'distance' we mean flexible dimensions of both space and time. In addition, distance has a moral dimension, which refers to a sense of responsibility towards other people and nature. The distance expresses whether an individual's focus is close or far away. For example, their visions of the apocalypse are far away from the children in terms of the time, space and moral dimensions.

When the children considered the technology theme, the distance could be expressed in terms of space – for example, from the home town to the moon. Technology in this sense is changing our visions in relation to the dimension of space. The more technology we have, the more opportunities we have to expand the world. Through technology we extend our reach, even to the moon. Technological visions were also evident in the research of Alerby (1998), Hicks & Holden (2007) and Fleer (2002), which addressed children's and young peoples' thoughts about the environment. Alerby refers to the children's "technological" thinking as a 'pragmatic view' of the environment.

Distance in both space and time was apparent in the career theme, as in the example where the child wanted to find cures for diseases. This can be seen as an expression of global concern and willingness to take personal responsibility, as well as to care for other people. In other words, it is an expression of moral closeness – care for people with whom someone has no experience of contact. In contrast, the child who sees himself working at home shows

an aspect of distance with a different meaning. Here, the distance in space is quite small but it does not say anything about the moral distance involved in this scenario. Working at home is made possible by the technology, which in this theme is viewed from the personal point of view, not from the society's point of view.

The theme of apocalypse expands the concept of distance, particularly with regard to the dimension of time. To children it seems that conflicts happen far away in the future, as in the drawing that is placed in the year 3049. The issue of environmental destruction is also found in Alerby's (2000) study of children's and young people's thoughts about the environment. She labelled children's drawings about the death or devastation of the forests as thoughts of the bad world. According to Beck (1994), focusing on risks and catastrophes makes people incapable of action. We, like Beck, can see that when the world is heading towards a catastrophe, human responsibilities are placed in an institutional context (like the child who felt that factories, rather than individuals, had the power to do something), instead of in the context of everyday life, where children are more easily able to retain a sense of responsibility.

The theme of sameness highlights important features of future visions. Although things might look the same in the drawings, some changes might be embedded in children's visions. It is taken for granted, for example, that people get older, probably get a job and might have a family. Other changes are harder to put into words. Children might worry that life in their future will be hard or boring. This theme therefore raises the issue of their emotional relationship with the future. At first sight, some visions seemed to lack a feeling of distance from the present. However, while studying children's comments relating to their pictures, we found temporal distances indicating an awareness of different time periods in life, e.g. adulthood. Also, this lack of distance might in some cases reflect a child's lack of appreciation of the pace of some changes, believing that environmental or other world events won't occur in their own lifetime.

We have been discussing distance from the children's perspective, using their experiences as a point of departure. In our study, we have seen how a group of children envision the future through varying distances. Distance has at least three dimensions – moral, spatial and temporal – and these have in common their relation to life experiences. No matter how far away on the moral, temporal and spatial scale someone's visions of the future are, the other end of the scale is firmly fixed in the life-world of that person.

We want to stress that through temporality it is possible to reflect intergenerational relations at a deeper level. This can be exemplified by Hicks and Holden's (2007) study among 11-year-old children. They found them to have a clear desire for a better quality of life in their local community but, when it came to environmental matters, two-thirds of the children expected more problems in the future. Especially in relation of global problems, children were generally negative. The notion that local prospects are more positive than global prospects was also found in our study. We consider this to be a question of distance, which we argue is one quality of temporality. In other words, distance helps us to understand temporality in a more nuanced way. Envisioning the future takes different expressions, depending on the chosen viewpoint between moral, spatial and temporal distances.

Temporality enables us to understand time as something more than just measurable "clock-time". Most of all, it provides a framework for discussing values in relation to the time, which from our point of view is especially needed in ESD. Almers (2009) discusses temporality in a distance moralistic framework. She underlines the importance for young people to have the opportunity to take a stand and develop action competence for the future. In addition,

Gidley (1998) claims that where conscious imagination is not cultivated, tacit images will creep in anyway. She explains this further by saying that if young people receive negative images of the future, it is not surprising if they end up feeling disempowered.

We consider ESD as a context in which it is relevant to deal with what we want the future to be, and in which children's visions of the future should be the obvious starting point. Our study shows how children interpreted open questions about their future mainly in four different ways: What is going to happen in the society in the future? What is going to happen to me in the future? What is the worst thing that can happen to the world in the future? How does it feel to become a grown-up?

We refer to the words of Gough (2006) in recognizing that we are engaged with a somewhat erratic process of learning our way into an uncertain future. To focus attention on the distances embedded in alternative visions could be one way for a teacher to open up discussions about preferred visions of the future. This means that when SD and the temporality in it are treated as something ultimately changing and open for criticism, it is easier to understand the effects of children's visions. SD has a moral and intergenerational aim. Addressing the issue of achieving a "better future" is therefore an on-going process in ESD. If we consider SD to be a process instead of fixed goal, we can agree that the target of SD is flexible. We stress that by looking into the different distances of future visions, we can find a meaningful and interesting access into ESD. All we can know is what we leave to the next generation, but we can't say anything of the later generations. All in all, each generation leaves its own legacy.

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RESEARCH ARTICLE

Geleceği Öngörmek – Zaman, Mekân ve Ahlak Konusu

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Özet

Bu makalede çocukların gelecek hakkındaki öngörüleri incelenecektir. Sürdürülebilir kalkınmanın özünü kuşaklararası ilişki oluşturmaktadır. Bu durum, bir insanın gelecek kuşaklara olan ahlaki sorumluluğu ile ilişkilidir. Ancak, bizler gelecek kuşakların bizimle aynı ihtiyaçlara ve tercihlere sahip olmalarını sağlayabilecek miyiz? Gelecek tartışmaları genellikle yetişkinlerin bakış açısıyla belirlenmektedir. Eğer çocuklara gelecekle ilgili görüşlerini sorulsaydı nasıl bir sonuç elde edilirdi? Teorik olarak bu çalışma canlı-dünya fenomenolojisine dayanmaktadır. Çalışma, 2011 yılında Kuzey İsveç'te gerçekleştirilmiştir. Çalışmaya, 11 ile 12 yaşlarında toplamda 22 çocuk katılmıştır. Çocuklara, "Büyüdüğünde gelecek neye benzeyecek?' sorusu sorulmuş ve çocuklardan soruyu çizim yaparak yanıtlamaları istenmiştir. Çalışmadan elde edilen verilerin analizlerinde dört tema ortaya çıkmıştır; *teknoloji, kariyer, kıyamet ve aynılık*. Çalışmadan elde edilen sonuçlara göre zaman, mekân ve ahlakî konuların çocukların öngörüleri ile iç içe olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Çocuk görüşleri, gelecek, sürdürülebilir kalkınma için eğitim, kuşaklararası ilişki, fenomenoloji.

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Mapping What Young Students Understand and Value Regarding Sustainable Development

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Abstract

This paper presents the results of a study carried out to investigate how 10-12 year old Swedish students understand and value the issue of sustainable development. The responses from open-ended questions in a questionnaire have been analyzed through a content analysis based on a phenomenographic approach. The results show that there are considerable variations in the level of understandings and the values related to the three aspects of sustainable development. Understanding within as well as between the aspects is noted, with students having the most difficulty in seeing the relationships between all three aspects, i.e. a holistic understanding. Furthermore, students' understanding and values are often expressed in an integrated way i.e. expressed in the same sentence. The variations, complex understandings, and expressions of understandings and values are discussed in relation to earlier research with a focus on ethical issues and systems thinking.

Keywords: Education for sustainable development, levels of understanding, values, student perspective, ethical reflections

Introduction

Education for sustainable development (ESD) is one of the international educational goals of United Nations (UNESCO, 2005), and also included in the Swedish curriculum (Skolverket, 2002; 2011). At the 2002 World Summit on Sustainable Development it was also stated that ESD is an investment for the future, and each country was encouraged to make resources available to develop ESD (UN, 2002). UNESCO has suggested the following key educational principles for the coming decade: interdisciplinary and holistic,

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value-driven, critical thinking, problem solving, multi method, participatory, decision making, applicability and locally relevant (UNESCO, 2005).

This article focuses on a study carried out in Swedish primary schools, where two of the suggested educational principles: *holistic and value-driven* are investigated. We posed questions to the students about what they know, and how they feel about the different aspects of sustainable development (SD). Through the questionnaire we tried to secure information both about their factual knowledge, i.e. understandings, and feelings or emotions in relation to SD. The results reveal how values form part of their understandings and feelings. By using this method the expressions of young students can assist in increasing our knowledge of ESD.

Understanding sustainable development

In some previous studies, young students' understandings of the three aspects of SD; ecological, economic and social, are explored separately. Results show that environmental/ecological understanding is in many cases, connected to personal emotions or values (Alerby, 2000; Palmberg & Kuru, 2000; Payne, 1998), economic understanding is difficult, but it is also socially and culturally contextualized (Belle, 2006; Davies & Lundholm, 2008; Furnham, 1987; Furnham & Cleare, 1988; Lundholm, 2007). Studies on poverty and social issues among children up to 11 years old reveal that they see poverty as unfair and believe that it has been caused by structural factors, e.g. caused by failures of social and economic systems (Belle, 2006; Feagin, 1975). Furthermore youngsters over 11 years old explain poverty both by structural factors and individualistic factors, e.g. behaviors of the poor. The understanding and perceived values of the relationship between ecological, economic and social aspects of SD in the 10-12-year-old age group have not been studied sufficiently.

When looking at a complex understanding of ESD, variations and relationships can be considered (Hjorth & Bagheri, 2006; Jonsson, 2007; Loughland, Reid, & Petocz, 2002; Wylie, Sheehy, McGuinness, & Orchard, 1998). One important perspective of SD is not only that it consists of several aspects, but also that these are related in complex ways. This is different from when school subjects in natural sciences are taught one by one and "classical science solves problems by breaking them down into elements and then focusing on the isolated elements" (Hjorth & Bagheri, 2006, p. 90). Systems thinking emphasizes that it is only when you understand the complex unity of all parts that you can understand the meaning and function of every consisting part and that the "relationships tie the system components together" (Wylie, et al., 1998, p. 118). In previous studies, young students describe concepts ranging from an object focus to a relational focus between objects (Jonsson, 2007; Loughland, et al., 2002). In similar ways they are capable of thinking in systems earlier than thought before (Magntorn, 2007; Wylie, et al., 1998). There are also variations in the understanding of sustainability issues, and the context is important in learning situations (Rickinson, 2001; Walshe, 2008).

The ideas behind systems thinking also deal with the ability of decision making (Dawidowicz, 2010), the main idea being that if the individual understands how things work in a system and how things affect each other, the ability to make good decisions increases (Hjorth & Bagheri, 2006). Decision making is very close to the concept of action competence within the ESD field (Jensen & Schnack, 2006). Action competence is defined as a will and an ability to decide and act for, in this case, sustainability, and it is seen as a crucial component in relation to learning about SD (Almers, 2009; Breiting & Mogensen, 1999; Jensen & Schnack, 2006; Mogensen & Schnack, 2010). Palmberg & Kuru (2000) argue that both knowledge and values play a major part in decision making. More specifically, knowledge about the interactive relations between man and nature together with personal values form a basis for a willingness to act.

Values within sustainable development

Nowadays, environmental problems are often seen as conflicts of interests between people, both globally and locally, that affect nature (Bäckstrand, Olsson, & Tengström, 2010; Kronlid, 2005; Lundegard & Wickman, 2007; Löfquist, 2010; Stenmark, 2000). Earlier views regarded environmental problems as technical problems to be solved or conflicts between human beings and nature. In the field of environmental ethics, discussions about development, welfare growth and social justice are ongoing with different perspectives (Lotz-Sisitka, 2007, 2009). The importance and understanding of the different contexts when learning about global issues as SD has also been discussed (Sporre, 2010). Reflections on different ethical issues raised in relation to ESD are recommended (Kronlid, 2005; Löfquist, 2010; UNESCO, 2005). Different moral statements articulated in a discussion are valued for ethical reflections, both contextualised and universal (Lotz-Sisitka, 2007; Löfquist, 2010). The ethical dimensions of SD have been highlighted, as well as looking at the environmental and climate ethics (Kronlid, 2005, 2009; Stenmark, 2000; Öhman & Östman, 2008). We can, according to Stenmark (2000), divide environmental ethics into human-focused (anthropocentric) or non human-focused (bio- or ecocentric) ethics. The field of ESD is, in terms of environmental ethics described as holistic and intergenerational anthropocentric. That means that SD focuses on a holistic and complex view of life and aims to improve peoples' welfare, both now and in the future which can only be reached if attention is paid to the ecological conditions of the world (Stenmark, 2000).

Moral issues, values and emotions are complexly related and ethical theory is an effort to come to grips with this. A way of looking at values as expressed through emotions is exemplified in Lifmark (2010), building on Nussbaum (2001), in contrast to some contemporary ethical theory emphasizing the pure rational capacity of human beings. Nussbaum argues, in a neo-Aristotelian tradition, for the importance of emotions for the understanding of value judgments and moral decision making (cf. Lifmark, 2010, p.98).

Understanding and valuing sustainable development

The importance of exploring learning processes in environmental education is described by Rickinson and Lundholm (2008), who focus on the learning challenges. One challenge deals with the emotional responses the students have to deal with when meeting the subject of environmental education. How the students respond has a direct impact on how they then learn (Rickinson & Lundholm, 2008). In a review from 2009, some new ways or lenses for understanding environmental learning are presented. One of them emphasizes emotions and values as important factors, especially when it comes to scientific literacy. Participation, critical thinking and moral reasoning are highlighted as important factors for environmental learning (Rickinson, Lundholm, Hopwood, 2009).

Littledyke (2008) argues for the integration of affective and cognitive domains in science education, with the aim of developing a sense of relationship with the environment. In school the concept "scientific literacy", i.e. the knowledge and understanding of science concepts and processes required for personal decision making, participation in civic and cultural affairs, is stressed in the science curricula (e.g. Millar & Osborne, 1998; Roberts, 2007) and since the end of the 1990s teaching of socio-scientific issues (SSI) have been used to cover that content. Many socio-scientific issues involve ethical reasoning, a decision or an opinion in a current media-reported issue which is usually based on both knowledge and values. Schools should prepare young people to engage and act in society, which requires not only knowledge about scientific phenomena, but also ethical considerations, generic skills such as team-work, problem-solving and media literacy (Osborne & Dillon, 2008; Ratcliffe & Grace, 2003). Several studies with students learning and discussing SSI questions, such as environment and climate, have shown that

emotions, values and moral reasoning play an important role in their arguments as well as their decision-making (Aikenhead, 2003; Ekborg, 2005; Grace & Ratcliffe, 2002; Sternäng, 2011; Walker & Zeidler, 2007). However, working with SSI does not always result in that. In a study by Ekborg et al. (2012), it is shown that teachers used the cases to create interest when introducing a topic, but, generally, they did not stress the ethical issues, the conflicts of interest or scientific content, and they did not create an awareness of the interdependence between society and science, even if this was stressed in the framework. The importance of emotions and values when learning ESD is also emphasized when discussing pro-sustainability and behavior (Maiteny, 2002). In a special issue of *Research in Science Education,42 (2012)* the role of the use of SSI in science education within the context of the UN Decade of Education for Sustainable Development is discussed further.

Alerby (2000) has, through the drawings of 7-16 years old children, analyzed their visualized thoughts about the environment. She found that children described the environment as either a good or a bad world or relations between them, and then, finally, they drew symbols or actions of environmental protection (Alerby, 2000). This is an example of how children integrate understandings and emotions in their expressions. A dialogue about *Learning in a Changing World* is introduced by Heila Lotz-Sisitka (2007) where issues like those above as well as culture, ethics and agency are discussed.

Student perspective

The OMEP (World Organization for Early Childhood Education) report from 2010 presents how children, from all over the world, describe the earth and SD with a deep sense of empathy. The authors' conclusions are that we should value the children's voices as an important factor for developing ESD in the world (Engdahl & Rabusicová, 2010). Important factors when working with young students are to pay attention to whether their thoughts are personal, self-centered and logical from their point of view (Helldén, 1994). Children's everyday thinking is very robust. According to Helldén (1994), language matters to children and it is very concrete. Since students have different experiences that have helped them to understand, Helldén argues that it is important that we, as researchers and teachers know more about how young students think to create learning situations where they are active participants and their thinking is challenged (Helldén, 1994). According to Payne, there has been "a lack of consideration in environmental education theory and research practices about the children who are the subjects of environmental education" (Payne, 1998, p. 20). What students understand about the issue of SD is valuable knowledge that can be used to develop teaching and learning of ESD, as well as empowering the children as world citizens and agents of change (McKenzie, 2006).

Aim

In this article, we have investigated how 10-12 year old students express their understandings of and feelings related to the different aspects of SD, as well as the relationships between the different aspects. The research questions were:

1. How do young Swedish students understand and value the aspects of SD and how these are related?
2. How can the relationships between understanding and valuing SD be described?

Method

This study is based on phenomenographic theory. From a phenomenographical point of view people experience, understand and ascribe meaning to a specific situation or phenomenon in different ways (Loughland, et al., 2002; Marton & Booth, 1997). The variations of concepts of a phenomenon are the most important. The interest lies in

developing teaching and learning through a deeper understanding of students' varied thoughts (Alexandersson, 1994; Marton & Booth, 1997; Svensson, 2011; Uljens, 1989).

Sample

The study was carried out during 2010 in 11 different classes in Swedish schools, involving 209 students in total (105 girls and 104 boys) aged between 10-12 years. Searching for students varied understandings of ESD in the Swedish school context schools were selected on the basis of official websites and background information from the teachers. The schools that agreed to take part were located throughout Sweden and in towns of varying sizes. They also represented variations between schools, with and without green/environmental profiles. Against this the background, the sample represents a diversity of 10-12-year-old Swedish students expressing their different views (cf.Agresti & Finlay, 2009). Recommended research ethics and confidentiality were also considered when conducting and performing the study (Vetenskapsrådet, 2002, 2011).

Instrument

For the study, a comprehensive questionnaire about ESD was created. This article reports the results from the open ended questions of the questionnaire, which deal with understanding and valuing the different aspects of SD: ecological, economic, and social, and the relationships between them. The open-ended questions were supported by pictures. A picture, as an artifact or conversation piece, has been shown to be useful in earlier studies (Hartman & Torstensson-Ed, 2007). Also, a variety of questions were used in the questionnaire due to the age of the children (Cohen, Manion, & Morrison, 2010; Creswell, 2005; Trost, 2007). In each aspect of SD, two questions were posed: one about knowledge and the other about students' feelings together with the accompanying picture.

Implementation

In order to avoid bias in content validity, pre-tests of the questionnaire were also carried out before visiting the participating classes. At the moment of students' answering, a researcher, in two cases a teacher, helped explain the questions, assisted slow readers and writers, and collected the students' answers. It generally took the students 25- 45 minutes to complete the questionnaire. All of the distributed questionnaires were responded, although not all of the questions. The questionnaires were filled in and gathered in the classes as a joint school activity. Through that volunteer bias was avoided which could otherwise be a problem with questionnaires (Cohen, et al., 2010).

Analysis

A content analysis of the answers was done in line with a phenomenographic approach searching for the variations in the ways students understood and valued SD (Marton & Booth, 1997; Uljens, 1989). After careful readings of the answers critical aspects for each question were explored and when identified used for the forming of categories. By a critical aspect is meant what is found to make up the qualitative differences between answers for each question *(*Alexandersson*,* 1994*;* Svensson*,* 2011*)*. The critical aspect when dealing with understanding in this study focuses levels of complexity and relational thinking (cf.Jonsson, 2007; Loughland, et al., 2002). When looking at valuing (cf. Lifmark, 2010; Rickinson, Lundholm, & Hopwood, 2009; Stenmark, 2000), the critical aspect focuses on the strength of the emotional expression and, or value judgment. Consequently the categories outline the different ways these young students' experience and describe the aspects of SD, but they do not primarily focus on the individual student (cf.Loughland, et al., 2002; Uljens, 1989). Each answer was seen as a unity and categorized according to the most significant statement, i.e. we did not analyze all the aspects of the statement, but used a more holistic interpretation. Exclamation marks and capital letters were seen as adding emphasis to the statement.

A content analysis implies interpretations of the students' writings. Through citations of the original statements, reliability and validity is shown (Cohen, et al., 2010; Creswell, 2005). For this article, the responses, originally in Swedish, have been translated into English. In the categorization, the statements were coded, which meant that they were possible to count. Frequency tables were made in order to analyze the percentage of different answers in the various categories.

Results

The results of how young Swedish students understand and value SD will be introduced in the following order: the level of understanding and values of: 1) the ecological aspect; 2) the economic aspect; 3) the social aspect; and, finally, 4) the relations between all of the aspects. This is the same order as the open-ended questions were posed in the questionnaire. Through the content analysis, categories were made and distinguished with the help of the critical aspects identified for each question. As already mentioned, the questions in the questionnaire had picture support. Consequently the picture and the questions jointly worked as triggers for the answers reported below. The actual questions are here translated into English and are presented below together with the respective pictures used in the questionnaire. In addition to reporting the results question by question, for question 1a and 1b an in-depth analysis has been carried out and is presented as Figure1.

1. The ecological aspect

1a What do you know about our environment?

1b How do you feel about the environment and the impact humans have had on it ?

Almost all, 95.2 %, of the students answered question 1a, concerning their understanding of the ecological aspect. Examples of their answers are given in Table 1.The students' answers were varied and the critical aspect for categorization was the degree of complexity. In the first category, the students made descriptions of both biotic and abiotic factors seen in the picture. In the second category, the students showed that they understood simple relations in the environment. In the third category, the students showed that they understood more complex ecological relations. The students' answers showed, both positive and negative emotions regarding relations in nature. Categories, frequencies and examples of students' statements are shown in Table 1. The answers were distributed in the different categories, with the highest response rate for simple relations, and these often expressed a negative emotion.

Question 1b, concerning the feelings of the students regarding the impact of human beings on nature, had a response rate of 89.5%. A variety of emotions and values were shown, many focusing on the negative impact of human beings on nature. When categorizing emotions and values, the strength of the value judgment was identified as the critical aspect. In the written responses we found statements that were more spontaneous, weak in judgment and more emotional; which were described as an emotional expression, for example: *"I think it is lovely to be out in the forest!" "I want the environment to get better!"*. We also found statements that had a stronger sense of judgment, then described as a value statement, for example: *"I think you should clean up stuff that others have thrown away." "We throw out a lot of things that can be recycled. We are also responsible for all of the pollution." "Bad!! I think people are violating nature.*

Nature is important for future generations!". Many of the statements included both emotions and stronger values and were categorized after its main expression.

Table 1.

Categories of students' understandings of the ecological aspect (question 1a) and quotations of students' answers in respective category.

Category	Example	%	N
No response	-	4,8	10
Description	"I see a fox, a rabbit, trees, water, flowers and a house." "There are bears and trees."	27,8	58
Understandings of simple relations	"A big factory emits bad smoke, which is not good for the animals or nature." "I know that the animals and the plants are important in nature."	51,7	108
Understandings of complex relations	"I know that big factories emit bad smoke, both humans and animals get sick from the smoke, even flowers and plants. It is bad that some people throw away waste in nature." "I know how trees flower and.... The rabbit eats the plants and the fox eats the rabbit. The fox dies and decomposes in the soil and then a plant grows again."	15,7	33

As already mentioned a comparative analysis was made combining how the students described what they knew about the environment (Q1a) and their feeling about humans in nature/ the environment (Q1b). The interesting result was that those who did not respond, or who just described the picture in question 1a, had a higher response rate in question 1b. Responding to Q1b they both expressed emotions and reported some factual knowledge. We noticed further that the more complex understanding the students showed in question 1a, the stronger value statements they also expressed in question 1b. In other words, the results show that those who displayed less knowledge in 1a could express what they knew if they started with expressing their feelings. Those who had a more complex understanding also showed stronger value statements.

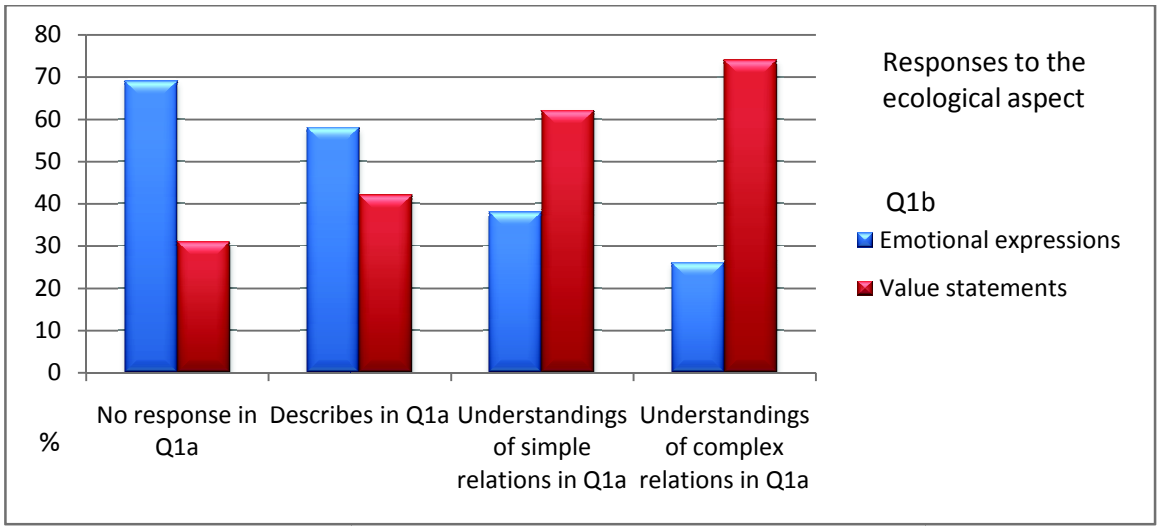

Figure 1. The students' ways of describing relations in Q1a, combined with their expressions of emotions and value statements in Q1b, in percentage within each category. Responses refer to the ecological aspect.

For Q1b the answers were categorized as either an emotional expression or a value statement even though there was not a sharp distinction between the two categories, but rather a continuum. A value statement could include emotional expressions, and vice versa, but was categorized according to the overall impression of the statement.

2. The economic aspect

2a - What do you know about how things are made and traded?

2b - How do you feel about that and how money is used?

As in the previous section about the ecological aspect, the first question within the economic aspect asked the students about their knowledge and the second question focused on their feelings. Question 2a had a response rate of 86.6 %. The critical aspect that was focused on here was the complexity, and this was divided into four different categories: the description of different goods; simple knowledge of goods and trade; economic issues related to ecological aspects; and economic issues related to social aspects. Knowledge and values were also integrated in the answers, even though to a lesser extent than in the ecological aspect. It was particularly noticeable among those who also described and understood that economy is related to the ecological and social aspects. Many answers expressed thoughts of fair trade and how long-distance transports affect the environment. The students were aware that Sweden imports goods from other parts of the world; however, none of the students wrote about Swedish export.

Table 2
Categories of students' understandings of the economic aspect (question 2a) and quotations of students' answer in respective category.

Category	Example	%	n
No response	-	13.0	27
Description	*"I see a fish, money, bananas and shoes.""Bananas grow on trees and the fish are caught and....I don't know."*	25.4	53
Relational understanding of goods and trade	*"They catch some fish and sell it to a country, then the fish travels in an aeroplane and in the end the fish is sold in a shop." "Many things are made in other countries and are flown to Sweden."*	36.4	77
Relational understanding of economy and ecology	*"The plane is there because things are transported a long way to be sold. That is absolutely not good for the environment!" "I do not like the stuff they put on the bananas to protect them from bugs. My family always buy eco-bananas and other fruits."*	16.7	35
Relational understanding of economy and social issues	*"In poor countries, children have to work all day to earn some money for their family. The goods are sold abroad and we, the rich people, are responsible for the poor children not receiving enough money." "You have to manufacture stuff…if you don't, you don't get money and then you cannot live."*	8.1	17

The responses to question 2b expressed values, emotions and money usage and had a response rate of 74.6 %. The critical aspect identified value judgments about economy,

either more general or more personal. Two main categories were formed; in the first category the value judgments were related to an individual economy and in the second category, they were related to national economy. Sub-categories were then defined through the different characters of their statements within those two main categories. This question was more difficult for the students to answer, since 25.4 % did not respond and the rest described mostly usage of money, often with a negative value judgment. The students' understanding of use of money is on an everyday level, but it is also connected to emotions of injustice and waste of money. However, many of the students have difficulties explaining where money comes from and factors that can affect economic circumstances, both on an individual and a national level.

Table 3.

Categories of emotions/ values within the economic aspect, dealing with trade and money (question 2b) and quotations of students' answers in respective category.

Category	Sub-category	Example	%	n
No response			25.4	53
Values related to an individual economy	*Everyday use –less value*	”You get money when you work and then most of it is used for food, when you pay for the food you can keep the change.” “You buy things for your money, you need money to live.”	18.7	39
	Consumption-stronger value	”I think that you should not waste money because money is important and you should not buy unnecessary things.” “I think that we use the money for bad things, for example to buy new clothes and toys. I think we should buy the most necessary things instead of buying things we don't really need.”	17.2	36
Values related to the national economy	*Appreciation of international trade*	”I think it is good that you can sell things to another country. The money is used pretty well.” “We should have euro because many other countries have that.”	10.5	22
	Critique of how money is used a certain way	”Money is wasted at unnecessary things when there are people starving.” ”Money is used in a wrong way, but you can give money to those who help save the environment.”	18.2	38
	Critique of how money rules; power and greed	”Money governs the world” ”I do not think that money should exist because is causes criminality.” “Money is many people's weakness.”	10.0	21

Question 3a, which focused on the level of understanding the students had on the social aspect via pictures of people's housing conditions, had a response rate of 90%. The students' described that there are rich and poor people in the world and that this is unfair. A few students wrote about causes of poverty/wealth and how we live in Sweden. The pictures shown had a strong impact on the children and they wrote more emotionally about the social aspect than the ecological and economic aspects.

3. The social aspect.

3a What do you know about the different life situations of people?

3b How do you feel about that?

Picture support to Q3 consisted in four pictures contrasting the conditions of children. One child was eating a hamburger, others were asking for food showing an empty plate. A simple hut was shown and a Swedish good house. Due to copyright restrictions the photos cannot be shown.

The critical aspect distinguishing the categories of understandings within the social aspect also dealt with levels of complexity. The first category contains descriptions of rich and poor in the world. The second category focuses on understandings/expressions of the different life conditions for rich and poor in a simple way. In the third category, expressions of what may cause the different life situations for people in the world, i.e. a complex understanding, is included. Sub-categories were also formed here since values/ emotional expressions were expressed within the category of simple understanding.

Table 4.

Categories of students' understandings of the social aspect (question 3a) and quotations of students' answers in respective category.

Category	Sub-category	Example	%	*n*
No response			10	21
Description		"I know that there are rich and poor people." "In some parts of the world people don't get food and are homeless"	31.6	66
Understanding of simple relationships	*No values*	"They live on the streets not in a house and look for food in rubbish bins." "I know that all children do not go to school. I know that some do not get clean water, and that they do not get so much food, and that they do not live in good houses."	28.7	60
	Values/ emotions about justice	"I think the world is pretty unfair! We get food everyday while children in other countries have to work for maybe a potato." "Children in other countries don't have clean water and food. I think it is awful if you look into how children live in other countries."	13.9	29
	Values/ emotions about welfare	"I would like all people to have it as good as we have it in Sweden. Here we are really spoiled because we have running water, we throw lots of things away and are choosy." "We are lucky in Sweden since we are a wealthy country. It is also very unfair because millions of poor people in the world die."	12.9	27

Table 4. *(Cont.)*

Complex understanding	*Values/emotions related to specific causes*	”In some countries when there are wars you get lack of money and are forced to work at the age of 11. They have almost no food and simple houses. We do not have wars in Sweden. We have food, clothes, big houses and lots of money. ” “Some don’t get food, clean water (or water at all) and they can’t live in real houses because they are poor and have to live in the streets. They often get sick and do not live as long as we do. They also suffer from many natural disasters such as earth quakes, hurricanes, floods and tsunamis.	2.9	6

Question 3b, which specifically focused the students’ feelings on the social aspect, had a response rate of 84.2 %. When dealing with emotions and values, the strength of the value judgment was identified as the critical aspect. In the first category, the statements were more spontaneous, weak in judgment but emotional, an emotional expression. In the second category, the statements had a strong sense of judgment, a value statement. Also within this aspect, an analysis was made of how emotions/values relate to the categories of understandings.

The results showed that emotional expressions, when compared with value statements, had the highest frequencies in all of the categories. More specifically, the students who did not respond to question 3a all responded with emotional expressions in question 3b. In the category of description there were 70.2% of emotional expressions, in the category of simple understandings there were 50% and in the category of complex understanding 83% of emotional expressions. Examples of an emotional expression: “I feel mean towards poor people” and “I feel sad for them”. Value statements were mostly about justice: “It is not fair that some people are poor!”.

Ten percent of all the answers in question 3b indicated action-oriented opinions: “I want to give money to the poor.” This is interesting as action-competence is an often discussed aspect of ESD. Only 1.4 % of all students made some reflections about factors causing poverty, e.g. “I feel sad for the poor people but what happened that put them in this situation?“. The statements about factors or causes lead to further reflection about relationships and system thinking and these are some of the most important issues of ESD.

4. Relationships in sustainable development

4 These are the aspects of SD, how are they related?
(Pictures from questions regarding all three aspects repeated)

Question 4 focused on the understanding of the relationships between all of the aspects within SD. This question had a response rate of 55%, while 45% of the students did not answer or answered that they did not know. It is obvious that this is the most difficult question to respond to, e.g.,”It is hard to explain” and ”I do not know how to write”.

The critical aspect distinguished which aspects of SD were related to each other and six categories were formed: category of description of the parts in the pictures; understandings of simple relations between the aspects; understandings of relations between ecology and economy; understandings of relations between ecology and social aspects; understandings of relations between economy and social aspects; and finally the category of relations between all of the aspects. Relationships between understandings and values were analyzed in this question as well. The students that describe relationships also write emotionally and some of them with value statements i.e. a relational understanding and value laden statements are integrated. Examples of this are shown in table 5.

Table 5.

Categories of students' understandings of relationships in sustainable development (question 4) and quotations of students' answers in respective category.

Category	Example	*%*	*n*
No response/ did not know	"It is hard to explain..."	45	94
Description	"Nature, money and food" "The earth - all of the things exist all over the world."	11.5	24
Understanding of simple relations	"All pictures are related because there is food in all of the pictures" "Everything concerns earth and nature because it all comes from nature.. sort of.."	22.5	47
Relate ecological and economic aspects	"When we manufacture something in a factory that will be sold throughout the world we destroy nature." "It is good and bad with factories. Factories make clothes but do also emit fumes into nature."	1.4	3
Relate ecological and social aspects	"We feel good when we spend time in nature." "The world feels bad from all pollution. You have to stop polluting so much." "We humans destroy nature more and more. We do not help the poor that much."	3.3	7
Relate economic and social aspects	"The countries with most money buy most of the stuff. The countries with less money have no power to change." "It is really sad that in some countries people live in luxury and in others they live in poverty, in nature there are bad factories that let out poison and exhausts fumes."	4.8	10
Relate all of the aspects	"Well, those who sell bananas get some money but are still poor. When the bananas are exported the air and water are polluted." "Poor people do not have that much money and have to work very hard. Rich people just want more money to start building dirty factories."	11.5	24

Summary

When summarising the results of young students' level of understanding and values of SD we find a rich diversity. The level of understandings was analysed through the critical aspect of complexity, and emotions and values were analysed through the critical aspect of the strenght of the emotional expression/value judgment. The analysis of relationships between the level of understanding and values was also carried out within every aspect and presented in the results.

The students had the least amount of difficulty answering questions regarding the ecological aspect, i.e. this had the highest response rate. Most of the students answered this question with descriptions of simple relations integrated with a negative emotion regarding the negative influence of human beings on nature. However, there was a variety

of answers ranging from a descriptive level to a complex level. The relations between the level of understanding and values in the ecological aspect show that higher complexity in the described understanding also relates positively to value statements rather than more spontaneous emotional expressions. Furthermore did the question about students' feelings result in answers from those who did not respond to the question about knowledge about the ecological aspect, and, to some extent, was this also reflected in the social aspect.

Regarding the economic aspect, most of the students expressed simple economic relations of goods and trade. However, in contrast with the result of the ecological aspect, they related economic issues to other aspects of SD. Within the categories of understanding relationships between aspects of SD, emotions and values were also integrated in the answers. The answers mostly focused on negative aspects of the use of money, unfair trade and long-distance transportation. These students also expressed values and understandings at both an individual level as well as at a national level of economy.

The social aspect turned out to be the most emotional in the responses. Most of the students' described their knowledge of people's different life situations. Generally, they did not relate social circumstances to either ecological or economic issues, and only a few of them wrote about the possible causes of poverty. When analysing values and emotions in this question, the results showed that emotional expressions had the highest response rate in all of the categories.

Finally, the question of relationships between the aspects of SD had the lowest response rate, only 55%, which indicates that this was the most difficult question to answer. Furthermore the students answered by expressing simple relationships. Among those who did actually describe the relations between some or all of the aspects, emotions and values were integrated in their answers.

Discussion

We asked how these students understood and felt about the aspects of SD, and studied if and how it was related in their statements. The answers from the students in this study show similarities with previous studies dealing with the complex understandings of both SD and environmental issues (Jonsson, 2007; Loughland, et al., 2002; Wylie, et al., 1998). As in those studies, these students expressed understandings within or between the objects asked about, which, in this case, were the aspects of SD.

What distinguishes this study from those listed above is that we also asked for students' feelings and found emotional expressions/value judgments to be present in the responses when questioning their understanding of the different aspects, not least in terms of injustice, environmental problems and a wish for change, e.g., "I want the environment to get better!" and "Money is wasted at unnecessary things when there are people who are starving".

The questions of injustice, environmental problems and change were also focused in comprehensive Swedish studies of "Children's vital issues". In that study, important questions for children in early school age are described. These children raised matters of justice, friendship and expressed concerns about the future (Hartman & Torstensson-Ed, 2007). In Palmberg & Kuru (2000), environmental knowledge and emotional attitudes were found to be important factors for taking environmental responsibility. In this study, young students' expressions about aspects of SD, understandings and emotions were also often integrated in the answers. This confirms that the ethical dimension and emotional aspect of environmental issues (Rickinson & Lundholm, 2008) is to be taken seriously when teaching SD, as has already been noted (Öhman & Östman, 2008).

Economic issues were somewhat difficult for these students to describe, and in the social aspect we could see expressions at a structural level rather than an individual level (cf. Belle, 2006; Feagin, 1975).

The interesting findings of this study are the specific relationships between understandings, emotions and values. In the ecological aspect, the question about their feelings made some of the students write more about their knowledge than the actual question about knowledge made them do. According to Lifmark (2010) emotions and value judgments are complexly interwoven. An ethical theory such as used by Lifmark can assist in interpreting the results of this and similar studies. The more complex understanding the students describe the more emotions and values they also seem to express. When we analyze the content of emotional expressions and value statements, we see that emotional expressions are more present in understandings of simple relations of all aspects as well as in understandings of the social aspect in total. Value statements occur more frequently in both the ecological and the economic aspects, and also, more specifically, in the more complex or relational understanding of these aspects. The development of value-driven education within ESD (cf. Öhman & Östman, 2008) needs to pay attention to how emotions and values form part of the students' understanding.

Coming to the results of the study concerning student participation, a few conclusions can be drawn. First we had a high percentage of answers, many of them rich in content. Second, some students spontaneously said, when answering the questionnaire: "No one has asked for our opinions like this before" and "I think these are really important questions but we have not really discussed them in class", which indicates that the writing in itself was a moment of meaning making. Important questions for ESD research and development are increasing participation (UNESCO, 2005) and empowering of children (Engdahl & Rabusicová, 2010; McKenzie, 2006; Payne, 1998), which this study also emphasize through its methodological approach. Third, some teachers in the classes said "Oh, now I got some new ideas of how to approach this issue of sustainable development!" This was both referring to the questions in the questionnaire and how their students dealt with it. This was a non-intentional by-product of the research, which was interesting to observe. The results of the study are in line with the phenomenographic theory of developing learning through a deeper understanding of students' thoughts (Doverborg & Pramling, 1992; Helldén, 1994; Marton & Booth, 2000). The choice of individual questionnaires was, of course, meant to give every student the opportunity to express their thoughts (Cohen, et al., 2010), but the personal empowering impact for the participants was a bit unexpected.

Conclusions and implications

The results show that knowledge, emotions and values were integrated in young students' expressions of SD. This means that ethical issues form an integrated part of ESD and could be a possible pedagogical starting point from which to involve students. Some of the students show a complex, relational understanding, but, in general the students' show a level of understanding which is at a less complex level, indicating problems in describing relationships between the aspects. Furthermore, the results show that complex understandings and values are related, which is important for decision making (cf. Dawidowicz, 2010; Hjorth & Bagheri, 2006; Palmberg & Kuru, 2000). Awareness about the formation of different emotions and values in relation to SD seems to be important for the development of ESD, which needs further research.

Considering the complex area of ESD, teachers' awareness about the importance of understanding relationships and systems thinking must be enhanced. We also wonder, together with Alerby (2000), if the Swedish school is a milieu where children's experiences and thoughts are given enough attention. This leads to another conclusion that deals with

the ideas of the method used in this study, which could also be useful for teachers. To start with exploring what understandings, emotions and values are around the issue can be of help and important if we want to reach an inclusive and participatory approach and develop ESD. The variations that will appear can be crucial in enabling us to reach a more complex understanding for all of our students and lead to firm co-operation and help us to learn from each other. In this way, a higher involvement could be reached and lead to action-competence among our students and the development of ESD.

▪ ▪ ▪

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Biographical statement

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RESEARCH ARTICLE

Öğrencilerin Sürdürülebilir Kalkınma ile İlgili Düşüncelerinin ve Değerlerinin Belirlenmesi

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Özet

Bu makalede 10-12 yaşındaki İsveçli öğrencilerin sürdürülebilir kalkınma ile ilgili düşüncelerini ve değerlerini belirlemek amacıyla yapılmış çalışmanın sonuçları sunulmaktadır. Açık uçlu sorulardan elde edilen bulgular fenomenografik yaklaşıma dayanan içerik analizi yoluyla analiz edilmiştir. Sonuçlar sürdürülebilir kalkınmanın üç boyutu ile ilgili öğrencilerin anlama ve değer düzeylerinde önemli farklılaşmaların olduğunu göstermektedir. Üç boyut arasındaki farklılık dikkate alınmış ve öğrencilerin bu üç boyut arasındaki ilişkiyi anlamakta zorlandıkları belirlenmiştir. Ayrıca öğrenciler anlayış ve değerleri sık sık birbirleriyle iç içe ifade etmişlerdir. Farklılıklar, kompleks anlamlandırmalar, düşünceler ve değerler etik ve sistemli düşünme üzerine odaklanarak tartışılmıştır.

Anahtar Kelimeler: Sürdürülebilir kalkınma için eğitim, anlama düzeyi, değerler, öğrenci bakış açısı, etik yansıma.

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RESEARCH ARTICLE

The Influences of Socio-demographic Factors, and Non-formal and Informal Learning Participation on Adult Environmental Behaviors

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Abstract

Multiple factors are likely to influence adult literacy regarding the natural environment and environmental issues, but very little research has been carried out in this area. The research presented in this article is intended to help address this information gap, by investigating influences on adult environmental literacy using data from a Minnesota environmental literacy survey. The article presents the research findings regarding the influence of demographic factors and of non-formal and informal learning on environmental behavior, one of the key dimensions of environmental literacy. Results from this study indicated that environmental behavior prediction was most improved by adding non-formal and informal learning participation. These results suggest that non-formal and informal learning options should be looked at more carefully for predictive possibilities.

Keywords: Environmental literacy; environmental education; environmental behavior, informal environmental learning; non-formal environmental learning.

The Impact of Non-formal and Informal Learning on Adult Environmental Behaviors

While it can be assumed that industry and other large-scale operations are a main cause of environmental degradation, individual citizens and decisions made by adults at an individual level, also have a significant impact on our natural environment. As Coyle (2005) pointed out, environmental problems caused by individuals are not only a problem but also are on the rise. This is a particular concern if individual citizens do not see that their decisions and actions are part of current and ongoing environmental degradation problems.

Research by Blake (2001) found however that "where the culprit is clear and a solution to the problem seems within the power of individuals to achieve, environmental action is more likely to occur" (p. 717). This is at least promising, but also highlights why it is imperative that environmental issues are clarified in ways that enable individuals to

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recognize that their singular impacts and actions do matter, and that their individual actions can positively influence environmental health. A key concept in this context is environmental literacy. Environmental literacy has been used to describe the confluence of an adult's knowledge about, and attitudes and behaviors toward, the environment (Coyle, 2005; Murphy, 2002, 2004, 2008). This aligns well with how the North American Association of Environmental Education (2004) has defined environmental literacy as individuals having knowledge regarding the environment and environmental issues, and having the ability and inclination to engage in independent environmental learning and action.

In addition to the formal environmental education offerings available in colleges and universities; environmental education has also been available at non-formal venues such as environmental learning centers; interpretive facilities; state, county, and city parks; national wildlife refuges; and at arboretums, botanical gardens, museums, and zoos. Beyond these possible learning settings, informal environmental education options via newspapers, magazines, television, the Internet, and even conversations with friends and family, have also been widely available for adults interested in learning about the environment and environmental issues. In spite of extensive formal, non-formal, and informal environmental education efforts, however, national and state-wide research studies in America (Coyle, 2005; Donovan, 2001; Mancl, Carr, & Marrone; 1999; Murphy, 2002, 2004; National Environmental Education & Training Foundation, 2001; Pennsylvania Center for Environmental Education, 2001; RoperASW, 2002) have indicated that adult environmental literacy is lacking, and has shown few signs of improving over the past decade. These and related studies have demonstrated that people's lack of knowledge about the environment combined with their attitudes and behaviors toward the environment are less than what is assumed to be minimally necessary for making informed decisions regarding pro-environmental behavior and actions. Directed and self-directed education are essential for addressing environmental literacy concerns.

Merriam and Caffarella (1999) highlighted that facilitating learning depends on knowing who your learners are, why they participate in learning activities, and understanding the ways in which adults learn. Understanding general adult audiences (citizens 18 years and older) is critical for education efforts regarding the environment since adults everywhere are making and acting on decisions that directly affect our air, land and water quality every day. Adults daily decide transportation options for themselves and their families, whether to use fertilizer or herbicides on their lawns or gardens, and, how disposal of their waste using trash bins, composting, or recycling will be carried out. Adults also have a significant influence on political officials' decisions regarding local, state, and national environmental use and issues. All of these individual and collective decisions and behaviors impact environmental quality, and are informed by aspects such as knowledge adults have about the environment, as well as their attitudes toward the environment (Coyle, 2005; Kollmuss & Agyeman, 2002; Koupal & Krasny, 2003; Smith, Rechenberg, Cruey, Magness, & Sandman, 1997). Having better information regarding factors influencing adult environmental literacy may help educators better understand their adult learners, enable improved tracking of trends in environmental literacy at state and national levels, and may be used in targeting environmental adult education efforts for optimum impact.

A myriad of factors influence adult literacy regarding the natural environment and environmental issues, but, research on general adult populations and environmental literacy has been sparse. The research presented in this article is intended to help address this information gap by investigating influences on adult environmental literacy using data from *The Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson,

2008). The article presents research findings regarding the influence of demographic factors, and non-formal and informal learning on environmental behavior, one of the key dimensions of environmental literacy.

Background

Kollmuss and Agyeman (2002) defined pro-environmental behavior as "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (p. 240). Exactly how knowledge about the environment impacts or influences a person's pro-environmental attitudes or behaviors is not fully clear based on research to date, but, basic environmental knowledge is recognized as important for informing or affecting positive environmental attitudes or behaviors (Abdul-Wahab, 2008; Fraj-Andrés & Martínez-Salinas, 2007; Frick, Kaiser, & Wilson, 2004; Maloney & Ward, 1973; McDaniel & Alley, 2005).

Several studies have investigated environmental knowledge, attitudes, and behavior relationships (Franzen, 2003; Holden, 1995; Murphy, 2002, 2004; Murphy & Olson, 2008; Environmental Education & Training Foundation, 1997; Environmental Education & Training Foundation, 1998; Environmental Education & Training Foundation, 2001; Pennsylvania Center for Environmental Education, 2001; Scott & Willits, 1994; White, 2006). In the main, a positive but weak association between increased environmental knowledge, a positive environmental attitude, and behavior changes to protect the environment has been identified (Coyle, 2005; Koupal & Krasny, 2003; Smith et al, 1997). Coyle (2005) reported evidence for instance that environmentally knowledgeable people are 10% more likely to save energy in the home; 50% more likely to recycle; 10% more likely to purchase environmentally safe products and 50% more likely to avoid using chemicals in yard care. Additionally, Hornik and Cherian's (1995) meta-analysis of recycling behavior found that the strongest predictors of recycling behavior were level of consumer knowledge of or awareness of recycling programs. Unfortunately, according to the research evidence, adults in the U.S. have relatively low levels of environmental knowledge. Coyle's (2005) research identified that "after three decades of school-based environmental education programs, only one-third of American adults can pass a simple test of environmental knowledge with a grade equivalent to A, B, or C" (9 questions or more answered correctly out of 12) (p.3).

To better understand the influences on levels of environmental literacy in order to increase knowledge and promote behavioral change, various researchers have investigated relationships between demographic variables such as age, education, income, and gender, and, environmental knowledge, environmental attitudes, and environmental behaviors. However, a review of this literature revealed that very few of these research studies have focused on general adult populations.

Research into the impact of age on environmental behavior has largely been grounded in Mannheim's (1952) theory of generations, which suggested that important historical events occurring at the adolescent and young adulthood phases of life can permanently impact a cohort throughout its existence. For example, Hallin (1995) found that participants who had been in their mid to late 20s during the Great Depression or during the Second World War were more likely to lead a frugal lifestyle and also to make significant efforts to reduce their waste (Hallin, 1995). This and other studies (e.g. Coyle, 2005) suggest that older adults, who were teenagers or older at the time of environmental catastrophes such as the Three Mile Island (1979) and Chernobyl (1986) nuclear disasters, may have higher environmental knowledge and behaviors than other adult age groups. However, Van Liere and Dunlap's (1980)

review of the aspect of environmental concern reported that "age is negatively correlated with environmental concern" (p. 183), a finding supported by results from Hsu and Roth's (1996) research in which younger community leaders in Taiwan scored higher on environmental attitudes and environmental knowledge than other adult age groups from the study. Research evidence regarding the impact of age on environmental literacy appears therefore inconclusive.

Similarly, research evidence varies regarding the relationships between gender and environmental literacy. Coyle's (2005) research found that women "typically express a more positive attitude toward the environment than men" (p. 81), a finding which supported those of Hines (1987) and Bord and O'Connor (1997). Chua and Aldrich's (2000) review of a decade of research on gender differences in environmental attitudes and behaviors found that "women report stronger environmental attitudes and behaviors than men" (p. 443), a pattern that was consistent across age and 14 countries. Other studies indicated that adult males have significantly higher environmental knowledge scores than females (Arcury & Christianson, 1993; Coyle, 2005; Kentucky Environmental Education Council, 2005, 2009; Kibert, 2000; Murphy, 2002, 2004; White, 2006).

Education and income do appear to have an impact on environmental knowledge and behaviors, at least for some groups. Research indicates that higher levels of education offer an advantage in respondent environmental knowledge scores (Hsu & Roth, 1996; Kaplowitz & Levine, 2005; Kentucky Environmental Education Council, 2005, 2009; National Environmental Education & Training Foundation, 2001; Nerbonne & Schreiber, 2005), while Arcury and Christianson's (1993) research indicated that participants' income was positively related to global environmental knowledge. In their meta-analysis of research on responsible environmental behavior, Hines, Hungerford, and Tomera (1987) found evidence of a weak positive relationship between income and environmental behavior, and between education level and environmental behavior. However, McDaniel and Alley (2005), from their study on land use practices in western Georgia, found that there was not a strong relationship between participants' education or income levels and knowledge of their local environment. Similarly, a survey considering the environmental knowledge, attitudes and behaviors of Kentucky adults, indicated that attitudes about the environment were not significantly different among the various educational levels (Kentucky Environmental Education Council, 2005).

It can be assumed that in terms of education, citizens who are interested in the environment or environmental issues will seek out choices beyond formal education venues. Non-formal and informal environmental education are options for citizens to gain more information, but, there is not much research on these for general adult populations. Non-formal education can be considered "organized activities outside educational institutions, such as those found in learning networks, churches, and voluntary associations," and, informal education as "the experiences of everyday living from which we learn something" (Merriam & Caffarella, 1999, p. 25). Informal learning options like television and newspapers have been identified as leading sources of information on environmental issues (Yavetz, Goldman & Pe'er, 2005), and, Mancl, Carr and Marrone (2003) found that their lowest literacy respondents were most likely to use informal learning options, or television, to gain their environmental information. Non-formal and informal environmental learning venues will be considered an important part of this research study to try to better gauge whether involvement in these self-directed education venues positively relate to pro-environmental behaviors.

Purpose of Study

The purpose of this study is to investigate the environmental behaviors of adults in Minnesota and possible factors that influence this, using data from the *Third Minnesota Report Card on Environmental Literacy: A Survey of Adult Environmental Knowledge, Attitudes and Behavior* (Murphy & Olson, 2008). Heimlich and Ardoin's (2008) literature review identified that there are many ways that behavior is discussed in the literature. For the Minnesota Report Card survey, adult citizens were asked to self-report the frequency of their recycling and food purchase behaviors, and their energy behaviors. While the Murphy and Olson (2008) report provided information on the basic knowledge, awareness and behavior of Minnesota adults regarding the environment, the researchers did not specifically address the role of age, gender, education and income along with non-formal or informal learning variables as possible predictors of environmental behaviors.

In order to address this information gap, the present study was designed to (1) measure the environmental literacy of Minnesota adults, in terms of knowledge, attitudes, and behavior scores (KABs); (2) explore possible relationships between Minnesota adults' KABs and their socio-demographic characteristics as well as their participation in non-formal learning and informal learning; and (3) determine the relative contribution of environmental literacy variables for predicting environmental behavior. The study used a conceptual framework shown in Figure 1.

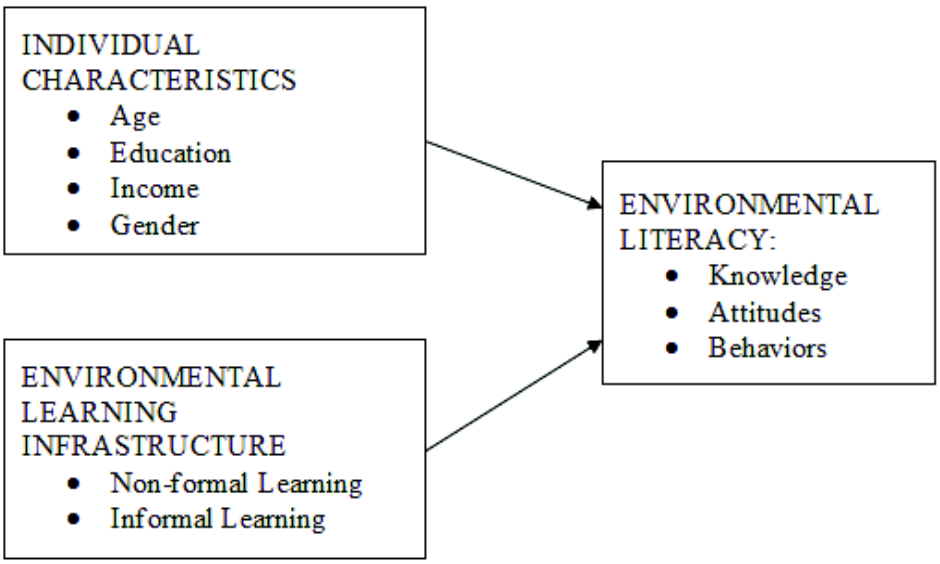

Figure 1. Influences on Environmental Literacy

This article focuses on the findings of the study relating to the influences of socio-demographic factors and participation in EE non-formal and informal learning on the behavioral dimension of environmental literacy. This is arguably the most important aspect of the study, since positive behavioral change is a key objective of environmental education efforts. Both non-formal and informal learning and a better understanding of other influences on behavior can help improve the effectiveness of pro-environmental education efforts.

The specific research questions addressing demographics and environmental behavior scores focused on the relationships between generation (age), level of education, income level, and gender, and, environmental behavior scores. Also analyzed were the relationships between non-formal and informal learning participation and environmental behavior scores.

Method

The research consisted of secondary analysis of survey and demographic data from *The Third Minnesota report card on environmental literacy: A survey of adult environmental knowledge, attitudes and behavior* (Murphy & Olson, 2008). The original survey data were collected by MarketLine Research using random digit dialing and computer aided telephone interviewing between August 24, 2007 and November 6, 2007 (Murphy & Olson, 2008) with an achieved sample of 1,000 adult residents of Minnesota, aged 18 or older.

The Third Minnesota report card on adult environmental literacy was based on the National Environmental Education & Training Foundation (2001) national report. Some questions, relating to popular environmental topics and issues that average citizens were expected to be familiar with, are identical between the two surveys. The latest Minnesota study (Murphy & Olson, 2008) also included additional questions relating to Minnesota adults' knowledge of global warming, and their attitudes toward environmental protection and responsibility. For the purpose of the analysis reported in this article, the independent variables from the Minnesota study are demographics and self-reported learning, and the dependent variable is environmental behavior.

Non-formal and informal learning participation variables from the Minnesota questionnaire contained seven items in total, including the following information used for the present study: gender; age (recorded as year of birth); highest level of education completed, and income before taxes.

The knowledge section of the Minnesota survey included two questions, with multiple possible answers, on self-reported environmental learning. First, using a five-point scale (where 1 = *use a lot* and 5 = *do not use at all*), respondents are asked how much "you use each of the following to get environmental information": the Internet; newspapers – hard copy or online; magazines – hard copy or online; television; radio; conversations with friends or neighbors; and conversations with children about their environmental learning experiences. For the purpose of the present study, the aggregate scores for this question were used as the informal environmental learning scores. Second, using the same five-point scale, respondents are asked "how much environmental information you get" from: government agencies (state or Federal); conservation or environmental groups; environmental learning centers including nature centers, parks, science museums, and zoos; and scientific experts. Aggregate scores from this question were used in the current study as non-formal environmental learning score. Responses for the non-formal and informal learning questions were reversed for the purpose of analysis so that a higher aggregate score on non-formal and informal learning corresponded with active engagement in participating in self-directed environmental learning. These aggregate scores ranged from 7 - 37 for informal learning, and from 4 - 22 for non-formal learning.

In the behavior section of the Minnesota survey, participants were asked to rate the frequency with which they perform each of twelve environmentally-friendly acts on a scale of 1 to 5, where 1 = *almost always do it* and 5 = *never do it*. The 11 specified acts were: recycle things such as newspapers, cans and glass; turn off lights and electrical appliances when not in use or when you leave the room; bike or walk to work; use the bus; carpool with others; purchase lamps, light bulbs, and appliances

that are energy efficient; run air conditioner less often in the summer; lower the thermostat in the winter; accelerate slowly when driving; donate money annually to an environmental group or organization; buy organic foods on a regular basis, and buy locally-grown foods on a regular basis. After recoding, the aggregate scores for these questions ranged from 15 - 56. The higher the aggregate score on the behavior questions, the more active the participant is assumed to be in environmentally friendly behaviors.

Data from the survey were analyzed using analysis of variance (ANOVA), *t*-tests and multiple regression. All statistical procedures were conducted using SPSS (version 17). To investigate the relationship of age, education, and income on environmental behavior (Questions 1, 2, and 3), one-way ANOVA was first used to analyze the extent to which the groups vary from one another with respect to the question's dependent variable (environmental behavior). Normality was assumed for each of the variables. In addition, the Levene's test of homogeneity was examined for significance. If the difference in means was significant ($p < .05$) for ANOVA, a post hoc Bonferroni test was conducted to show which group means were statistically different from one another. T-tests were used to compare mean environmental behavior scores for females and males (Question 4).

To address Questions 5 and 6, multiple regressions were conducted to consider whether any statistically significant correlations exist between the dependent measures, a set of predictor variables, and non-formal and informal learning participation. Specifically, multiple regression was conducted to investigate whether adding informal and non-formal learning participation to the other independent variables of age, education levels, gender, and income, further contributed to the predictive ability for environmental behavior score.

Results

Profile of Respondents

Fifty-eight percent of the sample was female, and the age range of respondents was 18 to 97, with an average age of 54 years. The full distribution of respondents by gender and age group is shown in Table 1.

Table 1
Frequencies and Percentages for Gender and Age of Respondents

Demographic	Category	*f*	%
Gender	Females	577	57.7
	Males	423	42.3
Age			
	28 or less	59	6.0
	29-42	207	20.9
	43-61	408	41.3
	62 or over	315	31.9
	Missing	11	1.1

The distribution of respondents by highest level of education and income is shown in Table 2. There was a fairly even split between respondents who had at least a two-year college degree (54%), and those who reported having only some college or less (46%). The largest proportion of respondents (22.8%) reported an income of greater than $50,000 to $75,000; followed closely by 21.7% reporting an income of greater

than $30,000 to $50,000. An income of $15,000 or less was reported by 6.9% of the sample.

Table 2
Frequencies and Percents for Highest level of education and Income levels

Demographic	Category	f	%
Highest level of Education completed*	High school graduate/GED or less	252	25.2
	Some college	207	20.7
	2 year degree	129	12.9
	4 year degree	245	24.5
	Graduate degree	166	16.6
Income levels*	$15,000 or less	62	6.9
	Greater than $15,000 to $30,000	141	15.7
	Greater than $30,000 to $50,000	195	21.7
	Greater than $50,000 to $75,000	205	22.8
	Greater than $75,000 to $100,000	128	14.2
	Over $100,000	169	16.6

*Missing cases were excluded

For the self-reported informal and non-formal environmental learning participation questions respondents were asked to gauge their use of a variety of sources. These sources: internet; newspapers; magazines; television; radio; conversations with friends or neighbors; and conversations with children about their environmental learning experiences, are referred to as informal environmental learning for this study. Aggregate scores for informal learning participation ranged from 7 to 37 (*M*=19.55, *SD*=4.71). These sources: government agencies; conservation or environmental groups; environmental learning centers including nature centers, parks, science museums, and zoos; and scientific experts, are referred to as non-formal environmental learning for this study. Aggregate scores for non-formal learning participation ranged from 4 to 22 (*M*=10.34, *SD*=3.82).

Table 3
Correlation of Study Variables to Adult Environmental KABs

	M	*SD*	1	2	3	4	5	6	7	8
1. Gender										
2. Education Level			-.090**							
3. Generation from year born			.020	-.161**						
4. Income Level			-.191**	.461**	-.206**					
5. Informal learning	19.55	4.71	-.043	.109**	-.099**	.125**				
6. Non-formal learning	10.34	3.82	-.108**	.286**	-.070*	.243**	.476**			
7. Knowledge	6.18	2.56	-.328**	.291**	.049	.287**	.242**	.325**		
8. Attitude	14.54	2.89	.103**	.088**	.020	.002	.185**	.145**	.145**	
9. Behavior	36.10	6.45	.086**	.164**	-.013	.144**	.396**	.348**	.178**	.267**

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed)

Correlation Scores

Table 3 shows the correlation scores for all study variables, including the environmental knowledge and attitude variables that are not explored in detail in the current article. Environmental knowledge scores were weakly positively correlated, and statistically significant, with education, income, and informal and non-formal environmental learning participation. Environmental attitude scores were weakly positively correlated, and statistically significant, with education, and informal and non-formal environmental learning participation. Environmental behavior scores (*M*=36.1, *SD*=6.45) were found to be weakly positively correlated, and statistically significant, with education, income, and informal environmental learning participation and non-formal environmental learning participation.

Assuming a positive relationship between each of the dependent variables (environmental knowledge, attitude, and behavior scores), and the independent variables of age, education levels, and income levels, the statistics do indicate a weak positive relationship. In other words, as age, education and income levels increase, so do knowledge, attitude and behavior scores.

Impact of Age

One-way between-groups ANOVA was conducted to explore the impact of age on environmental behavior scores. Subjects were divided into four groups according to their age (Group 1/Generation Y: 28 years or less; Group 2/Generation X: 29 to 42 years; Group 3/Baby Boomers: 43-61 years; Group 4/Silent Generation: 62yrs or older) (age groups based on Smith & Clurman, 1997 & 2007). There was found to be a statistically significant difference at the $p < .05$ level between the age groups for the environmental behavior scores (Table 4).

Table 4
Summary of Age Groups and KAB's Analysis of Variance (ANOVA) Results

Variable	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
Behaviors					
Between Groups	1,681.84	3	560.61	14.10	.00**
Within Groups	39,174.52	985	39.77		
Total	40,856.37	988			

**$p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and ages, only the Baby Boomer generation's mean behavior score (*M*=37.51, *SD*=6.29) was significantly different (higher) from each of the other three generations' mean behavior scores (Table 5). Generation Y (*M*=33.69, *SD*=6.01) had the lowest mean behavior score of the age groups. Generation X (*M*=35.87, *SD*=5.98), Generation Y, and Silent Generation's mean behavior scores (*M*=34.82, *SD*=6.59) did not differ significantly from each other.

Impact of Education

One-way between groups ANOVA was conducted to explore the impact of education on behavior scores. Subjects were divided into five groups according to their education levels (Group 1: High school grad, GED or less; Group 2: Some College; Group 3: Two-year degree; Group 4: Four-year degree; Group 5: Graduate degree).

There was found to be a statistically significant difference at the $p < .05$ level between these groups for their KAB scores (see Table 6).

Table 5
Bonferroni Comparison for Age Groups and Environmental Behaviors

Variable	Mean Behavior Score Difference	Std. Error	*p*	95% CI Lower Bound	95% CI Upper Bound
Baby Boomers vs.					
Generation Y	3.81*	.88	.00	1.49	6.14
Generation X	1.64*	.54	.02	.21	3.06
Silent Generation	2.69*	.47	.00	1.44	3.94
Generation X vs.					
Generation Y	2.18	.93	.12	-.28	4.64
Silent Generation	1.06	.56	.37	-.43	2.55
Silent Generation vs.					
Generation Y	1.12	.89	1.0	-1.24	3.49

*$p < 0.05$

Table 6
Summary of Education and KABs Analysis of Variance (ANOVA) Results

Variable	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
Behaviors					
Between Groups	1,364.13	4	341.0340.30	8.46	.00**
Within Groups	40,060.25	994			
Total	41,424.38	998			

*$p < 0.05$, **$p < 0.01$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and education, Group 1 (High school grad, GED or less), and the Group 4 (Four-year degree) and Group 5's (Graduate degree) mean behavior scores (see Table 7) were significantly different from each other. Group 1's mean behavior scores (*M*=34.85, *SD*=6.74) were lower than both Group 4 (*M*=36.72, *SD*=6.32) and Group 5's mean behavior scores (*M*=38.20, *SD*=6.59). Group 5's mean behavior scores were also significantly different (higher) from all groups except Group 4. Group 4 and Group 5's mean behavior scores however did not differ significantly from each other nor did Group 2 (*M*=35.85, *SD*=5.60) or Group 3's (*M*=35.08, *SD*=6.44) mean environmental behavior scores significantly differ.

Table 7
Bonferroni Comparison for Education Levels and Environmental Behaviors

Variable	Mean Behavior Score Difference	Std. Error	*p*	95% CI Lower Bound	95% CI Upper Bound
Group 5 vs.					
Group 4	1.48	.64	.21	-.32	3.27
Group 3	3.11*	.75	.00	1.02	5.21
Group 2	2.35*	.66	.00	.49	4.21
Group 1	3.35*	.63	.00	1.56	5.13
Group 4 vs.					
Group 3	1.64	.69	.18	-.31	3.58
Group 2	.88	.60	1.0	-.81	2.56
Group 1	1.87*	.57	.01	.27	3.47
Group 3 vs.					

(Cont.)

Table 7 (Cont.)

Group 2	-.76	.71	1.0	-2.76	1.24
Group 1	.23	.69	1.0	-1.70	2.17
Group 2 vs.					
Group 1	.99	.60	.96	-.68	2.67

*$p < 0.05$

Impact of Income

One-way between groups analysis was conducted to explore the impact of income on behavior scores. Participants were divided into six groups according to their income levels (Group 1: $15,000 or less; Group 2: Greater than $15,000 to $30,000; Group 3: Greater than $30,000 to $50,000; Group 4: Greater than $50,000 to $75,000; Group 5: Greater than $75,000 to $100,000; Group 6: Over $100,000). There was a statistically significant difference at the $p < .05$ level between these groups for behavior scores (Table 8).

Table 8
Summary of Income Levels and KAB's Analysis of Variance (ANOVA) Results

Variable	*Sum of Squares*	*df*	*Mean Square*	*F*	*p*
Behaviors					
Between Groups	957.20	5	191.44	4.74	.00**
Within Groups	36,135.79	894	40.42		
Total	37,093.00	899			

**$p < 0.01$

Table 9
Bonferroni Comparison for Income Levels and Environmental Behavior

Variable	Mean Behavior Score Difference	Std. Error	*p*	95% CI Lower Bound	95% CI Upper Bound
Group 6 vs.					
Group 5	2.12	.75	.07	-.07	4.31
Group 4	1.44	.66	.44	-.51	3.38
Group 3	2.33*	.67	.00	.36	4.29
Group 2	2.94*	.73	.00	.81	5.07
Group 1	3.26*	.94	.01	.48	6.04
Group 5 vs.					
Group 4	.10	.28	1.0	-.71	.92
Group 3	.75	.28	.11	-.07	1.58
Group 2	1.16*	.30	.00	.27	2.04
Group 1	2.64*	.38	.00	1.52	3.75

(Cont.)

Table 9 (Cont.)

Group 4 vs.					
Group 3	.65	.25	.13	-.08	1.37
Group 2	1.05*	.27	.00	.26	1.84
Group 1	2.53*	.36	.00	1.49	3.58
Group 3 vs.					
Group 2	.40	.27	1.0	-.40	1.20
Group 1	1.88*	.36	.00	.83	2.94
Group 2 vs.					
Group 1	1.48*	.37	.00	.38	2.58

*$p < 0.05$

Post-hoc comparisons using the Bonferonni test indicated that for environmental behaviors and income, only Group 6's mean (*M*=37.87, *SD*=6.42) was significantly different (higher) from the Group 1 (*M*=34.61, *SD*=7.65), Group 2 (*M*=34.94, *SD*=6.69), and Group 3 (*M*=35.55, *SD*=6.63) behavior score means (see Table 15). Group 4 (*M*=36.44, *SD*=5.60), Group 5 (*M*=35.76, *SD*=5.89) and Group 6's s mean environmental behavior scores did not differ significantly from each other (Table 9).

Impact of Gender

Independent samples *t*-tests were used to compare mean scores for females and males, and there was found to be a significant effect for gender and environmental behavior scores $t(998) = -2.72$, $p = .01$, with females having higher environmental behavior scores than males. The magnitude of the differences in these means was very small (eta squared = .007) (Table 10).

Table 10
Behavior means and standard deviations for females and males

Variable	*Females*	*Males*
Behaviors	*M*=36.57, *SD*=6.42	*M*=35.45, *SD*=6.42

Table 11
Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Behavior

	Step 1			Step 2		
Predictor Variables	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Intercept	33.16		.84	29.14		.90
Individual Characteristics						
Education	.58	.16	.13**	.27	.16	.06
Gender	1.50	.42	.12**	1.81	.40	.14**
Income	.31	.16	.07	.16	.15	.04
Belong to Gen Y or not	-3.66	.88	-.14**	-3.40	.84	-.13**
Belong to Gen X or not	-2.22	.55	-.14**	-2.13	.52	-.14**
Generation Silent or not	-2.27	.51	-.16**	-2.04	.49	-.14**
Environmental Learning						
Non-formal				.53	.06	.31**

Note. $R^2 = .08$ for Step 1; $\Delta R^2 = .17$

*p<.05, **$p < 0.01$

Impact of Participation in Non-Formal Learning

Hierarchical multiple regression was conducted to assess the impacts of participation in non–formal environmental learning on environmental behavior scores in addition to age, education, gender, and income (see Table 11). Age (categorized into Generation Y, Generation X, Baby Boomers, and Silent Generation), education, gender, and income variables were entered at Step 1, this accounted for 8% of the variance in environmental behaviors. After entry of non-formal learning participation at Step 2, the total variance explained by the model as a whole was 17%, $F(7, 892) = 26.33$, $p<.0005$. In other words, participation in non-formal environmental learning can explain at least nine percent of the variation of adult's environmental behaviors.

Impact of Participation in Informal Learning

A hierarchical multiple regression was conducted to assess the impacts of participation in informal environmental learning on environmental behavior scores in addition to the influence of age, education, gender, income (see Table 12). Age, education, gender, and income variables were entered at Step 1, this accounted for 8% of the variance in environmental behavior. After entry of informal learning participation at Step 2, the total variance explained by the model as a whole was 21%, $F(7, 892) = 34.27$, $p<.0005$. In other words, participation in informal environmental learning can explain at least 13% of the variation of adults' environmental behaviors.

Table 12
Results of Hierarchical Regression Analysis for Variables Predicting Adult Environmental Behavior

Predictor Variables	Step 1			Step 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Intercept	33.16		.84	23.76		1.09
Individual Characteristics						
Education	.58	.16	.13**	.48	.15	.11**
Gender	1.50	.42	.12**	1.64	.39	.13**
Income	.31	.16	.07	.24	.15	.06
Belong to Gen Y or not	-3.66	.88	-	-3.19	.82	.12**
	-2.22	.55	.14**	-2.17	.51	-.14**
Belong to Gen X or not	-2.27	.51	-	-1.50	.48	-.11**
			.14**			
Generation Silent or not			-	.49	.04	.37**
			.16**			
Environmental Learning Informal						

Note. $R^2 = .08$ for Step 1; $\Delta R^2 = .17$

*$p<.05$, **$p < 0.01$

Discussion

Only the Baby Boomers' mean score for environmental behavior was significantly different (higher) than the other age groups, with Baby Boomers scoring on average about two points higher than the other age groups. Returning to Van Liere and Dunlap's (1980) application of Mannheim's theory (1952) regarding significant events and possible generational impacts, it could be assumed that people who were teenagers and older during significant environmental events could have formed "an ecology-minded generation whose commitment to environmental reform should not

disappear as they move into adulthood" (Dunlap & Van Liere, 1980, p. 183). Many Baby Boomers were at least teenagers or older during many significant environmental events in the United States (Rachel Carson's book; Cuyahoga River catching on fire; Love Canal, Three Mile Island, and Chernobyl).

With regard to education levels and environmental behavior, participants with at least a four-year college degree (education groups four and five) had mean behavior scores that were significantly different from Group 1 (high school graduate, GED or less). Group 1's environmental behaviors scores averaged almost two points less than college graduates, and almost three points less than participants with a graduate degree. These findings align with the weak positive relationship between level of education and environmental behaviors found in Hines, Hungerford and Tomera (1987) meta-analysis on responsible environmental behavior research.

There were statistically significant differences at the $p < .05$ level between the income groups and behavior scores. Group 6's average mean environmental behavior score was significantly different (higher) from Groups 1, 2, and 3. Participants who reported a total household income of $100,000 or more (Group 6) then reported slightly higher environmental behaviors (average environmental behavior scores were 2 to 3 points higher) than Groups 1, 2, and 3. These findings support the weak positive relationship between pro-environmental behavior and income indicated in Mancl et al.'s (2003) and Hines et al.'s (1987) studies.

This study found a significant effect of gender on environmental behavior scores. These findings aligned with Coyle (2005), Hines et al. (1987), and Bord and O'Connor (1997) that females report more pro-environmental behaviors than males.

Results from the hierarchical regression analysis were aligned with the findings from the correlation analysis but revealed other noteworthy results. The multiple regression analysis revealed that the predictor variables of age, education, income, and gender accounted for approximately 8% of environmental behaviors. When non-formal environmental learning was added to these models, it contributed significantly to predicting environmental behavior scores. These prediction models increased 17% for environmental behaviors after non-formal environmental learning participation was added. After controlling for the effects of demographic variables, non-formal learning participation appears to be a moderate contributor to environmental behaviors. This finding is consistent with the meta-analysis on environmental literacy in the United States conducted by Volk & McBeth (1996, 1998).

When informal environmental learning was added to the first stage model, this variable was found to contribute significantly to predicting environmental behavior scores as well. The prediction models increased from 8% to 21% for environmental behaviors after informal environmental learning participation was added. After controlling for the effects of demographic variables on environmental behaviors, informal learning participation appears therefore to be a moderate contributor to environmental behaviors.

The multiple regression results therefore indicated that both non-formal and informal learning participation, when added to age, education, income, and gender, have a significant impact on environmental behavior. There was also evidence (not reported in detail here) that participation in non-formal and informal education improved environmental knowledge and attitudes, as well as behavior models, providing evidence for the value and need for non-formal and informal environmental adult education venues.

This has significant implications for the future use of non-formal and informal learning venues as a means of influencing environmental behavior among adults. While the

potential for using non-formal and informal education venues to improve and support environmental KABs has long been recognized, researchers and practitioners have raised concerns regarding the possible quality and effectiveness of these venues (Clover, 2002; Coyle, 2005; Filho & Bandeira, 1995; Nyirenda, 1995). The results of this study, in which the environmental behavior prediction was most improved by adding non-formal and informal learning participation, suggests that these learning options should be looked at more carefully for predictive possibilities.

However, since at least 75% of the model remains unaccounted for, more work needs to be done to achieve a clearer understanding of the factors influencing environmental behavior, so that formal, non-formal, and informal education can be appropriately designed and targeted for maximum positive impact on environmental behavior.

It is promising that one of the five main themes identified for increased education research by the Office of Educational Research and Improvement of the U.S. Department of Education is that of adult learning and environmental education (Smith-Sebastio, 1998). Researchers have also called for an increase in focused efforts at teaching environmental education to adults, due to their apparent lack of environmental knowledge and pro-environmental behavior (Clover, 2002; Environmental Education Training Partnership, 2004; Whelan, Flowers & Guevara, 2004). However, there has been a significant gap in the research and evidence base needed to inform the design of effective adult environmental education (Whelan et al., 2004). The findings of this study, particularly with regard to the predictive role of non-formal and informal education, help to address this gap.

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Biographical statement

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RESEARCH ARTICLE

Sosyo-Demografik Faktörlerin, Örgün ve Yaygın Öğrenmeye Katılımın Yetişkinlerin Çevre Davranışları Üzerinde Etkileri

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Özet

Yetişkinlerin çevre okuryazarlığını ve çevresel konulara bakış açılarını birçok factor etkileyebileceğine rağmen, bu alanda çok az araştırma yürütülmüştür. Bu makalede sunulan araştırma, Minnesota çevre okuryazarlığı anketinden elde edilen verileri kullanılarak yeişkinlerin çevre okuryazarlığını etkileyen faktörleri belirleyerek, bu bilgi boşluğunun giderilmesine yardımcı olmak amacıyla tasarlanmıştır. Makal,e demografik faktörler ve, çevre okuryazarlığının temel yaklaşımlardan biri olan çevresel davranış üzerine örgün ve yaygın öğrenmenin etkileri ile ilgili araştırma bulgularını sunmaktadır. Araştırmanın sonuçları, çevresel davranışın geliştirlmesinde genel olarak yaygın ve informal öğrenmenin birbiriyle ilişkilendirilmesinin etkili olduğunu göstermiştir. Bu sonuca göre örgün ve yaygın öğrenme seçeneklerinin öngörülen imkanlara göre daha ayrıntılı ele alınması önerilmektedir.

Anahtar Kelimeler: Çevre okur-yazarlığı, çevre eğitimi, çevreye yönelik davranışlar, yaygın çevre öğrenimi, örgün çevre öğrenimi.

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RESEARCH ARTICLE

Development and Validation of an Instrument for Assessing Climate Change Knowledge and Perceptions: The Climate Stewardship Survey (CSS)

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Abstract

The Climate Stewardship Survey (CSS) was developed to measure knowledge and perceptions of global climate change, while also considering information sources that respondents 'trust.' The CSS was drafted using a three-stage approach: development of salient scales, writing individual items, and field testing and analyses. Construct validity and alpha-level reliability was conducted on the 122-item test instrument to produce a refined 84-item CSS. The field tested CSS includes five scales (1) Impacts of Climate Change, (2) Causes of Climate Change (3) Misunderstandings about Climate Change (4) Issues and (5) Policy. Four knowledge dimension sub-scales and seven perception dimension sub-scales are included in the accepted instrument. The CSS is particularly applicable to studies interested in measuring potential respondent's ideas on the impacts, causes, and misunderstandings that are important to global climate change knowledge and perceptions as they relate specifically toward climate change issues and policy.

Key Words: Climate stewardship survey, CSS, climate change knowledge and perceptions

Introduction

"Climate change deniers have seriously impeded the development of rational policies to deal with what the best scientific research tells us is happening with our climate, a distortion that may prove to have fatal consequences" (Schwartz, 2011, p. 119) is the strong nature of the language emanating from one segment of today's multifaceted climate change debate. Other perspectives springing from the social milieu range from

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messages fictionalized by movie screen writers as entertainment (Bedford, 2010; Heffron & Valmond, 2011); newspaper opinion-editorial columnists advocating their opinions (e.g., Ambrose, 2011; Murdoch, 2008); statements of "fact" espoused by experts in fields other than climate science (ex. Chapman, 2008); organized "deniers" as Schwartz (2011) has noted; and politicians polarizing the arguments (Dunlap & McCright, 2008); to those who simply do not know enough about the topic to make an informed statement. In order to determine how to improve sound communication regarding climate science amongst the varied, and often divergent, perspectives we must put ourselves in a position to educate the population about the pertinent issues and work toward propagating climate scientists, or at least those knowledgeable about climate science, throughout our education systems—systems both formal and informal. Thus, if epistemology is the study of how we know, in this case how we know the science of climate change, then *agnotology* is the study of what we do not know (Proctor & Schiebinger, 2008). Our higher education research system has a strong background in epistemology and disseminating knowledge about how we know climate change science, however, in order to develop a cognizant population that can communicate about climate change from factual, data-driven positions, rather than from emotional and/or political positions, it is time to also develop approaches toward the study of what we do not know and how it is, from a broad cultural perspective, that we do not know it.

This paper outlines the development and validation of a survey instrument aimed at gathering data regarding several aspects of what a population knows and does not know about climate change, how that knowledge has come about, and the population's perceptions toward climate change as an initial piece of a larger research project. The aim of the larger project was to work with citizens from formal and informal learning environments to make educated climate change-related decisions and enable them to become solution providers rather than potential disseminators of disinformation—*agnogenesis* (Bedford, 2010) perpetuators as it were—whether intentional or not. The question immediately at hand though is how can we leverage the plethora of current climate change-oriented survey instruments and modify them and/or develop and validate new instrument scales to meet these needs?

Environmental Psychology Survey Instruments

Approaching environmental perception and knowledge study by means of survey instrument has been well established over the last four decades. As early as the 1970s, Maloney and Ward (1973) recognized the importance of the influence of knowledge on one's behavior in terms of ecological psychology and how investigating that knowledge is a crucial step toward behavioral modification. It was through a 130-item survey instrument that they sought to…

> … determine what the population "knows" regarding ecology, the environment, and pollution; how they feel about it; what commitments they are willing to make; and what commitments they do make. These are necessary antecedent steps that must be made before an attempt can be made to modify critically relevant behaviors. (1973, p. 584)

Maloney and Ward were entrenched within the post-Silent Spring (Carlson, 1962) era when environmental psychology was expanding from investigations of traditional architectural and spatial human environments—"*proximics"* as Wohlwill called it (1970, p. 304)—toward that of the environment being considered in terms of the larger context of wide-scale pollution and the depletion of natural resources. Wohlwill issued a challenge to psychologists of the time to consider the importance of the study of

"attitude formation and change, and its application to environmental problems" (1970, p. 308). While the study of human environments has multidisciplinary roots reaching back to the 1930s with Henry Murray's development of the notions of environmental *press* and *pressive apperception*—unconscious reactions to the potential of the environment (1938)—and Kurt Lewin's psychological field theory (1936) derived from physics, it has been the wide-reaching use of survey instruments that has proved helpful in meeting Wohlwill's 1970 challenge.

Survey instruments have been used to investigate at least five broad categories related to humans and the environment in terms of Wohlwill's larger context of environment—that which supersedes the proximics of buildings and city spaces of prior research. According to Walker (2010) surveys have been used since the early 1970s to gain access to a variety of populations' (1) knowledge of, (2) attitudes toward, (3) values pertaining to, (4) behavior toward, and (5) affect toward the natural world. Since 1973, no less than eighteen broad-ranging, published instruments have been developed and administered to groups ranging from adult populations; graduate, undergraduate, secondary, and elementary students; and to students' parents. These studies have been as far reaching as Canada, Australia, Taiwan, the United States of America, Poland, Hong Kong, Turkey, Switzerland, Greece, and Indonesia (Walker, 2010), and likely further. Of these instruments though, none pertain to more recent controversies related to global climate change.

Climate Change Survey Instruments

Spawned by notions of energy efficiency, environmental externality costs, regulatory policy movements, and the advent of publications related to climate change of the late 1980s and early 1990s, studies related to climate change knowledge and perceptions began to emerge. For instance, Kempton's ethnological interviews of "ordinary citizens" (1991, p. 183) and their conceptualizations related to energy consumption and global climate change informed Read, Bostrom, Morgan, Fischhoff, and Smuts' development of a risk-analysis oriented, structured questionnaire to access a sample of the general public's knowledge of "causes and effects of global warming" (1994, p. 971). In their follow-up study 17 years later they found the public's perceptions had changed little (Reynolds, Bostrom, Read, & Morgan, 2010) despite increased public awareness efforts on the issue.

The Read, Bostrom, Morgan, Fischhoff, and Smuts' questionnaire-style longitudinal study focused on the mental models of their population and considered their sample population's knowledge of (1) facts, (2) causes, (3) effects, and (4) policy effects related to climate change. Other investigators, in the more recent past, have considered knowledge from a variety of different perspectives, as well as a variety of different populations. For instance, Boon (2009) used a 7-item, self-report instrument to investigate high school students' knowledge of the (1) causes of the greenhouse effect and (2) climate change, (3) climate change vs. ozone depletion, and perceived (4) impacts of climate change. She then compared her Australian students' results to those of a 1991 study of similarly aged UK students finding that "both seem to be under-informed" (Boon, 2009, p. 55).

Sundblad, Biel, and Gärling took a different approach, analyzing (1) knowledge of the current state of climate change, (2) causes of climate change, (3) impacts of climate change, and (4) confidence in knowledge [self-efficacy] of Swedish "experts, [environmental] journalists, politicians, and laypersons" (2009, p. 281). As one might imagine, the results spanned a broad spectrum on their four scales.

Numerous other climate change survey investigations have been conducted in the recent past, however, they are too abundant to detail here. Yet, a brief outline demonstrates a growing body of climate change perception and knowledge research using survey instruments to gather data. For example, Brody, Zahran, Vedlitz, and Grover (2008) looked at public perceptions of climate change in the context of risk perception and spatial location. Similarly, yet on a more practical scale, Borberg, Cone, Jodice, Harte, and Corcoran considered a variety of knowledge and preparatory behaviors of "Oregon coast professionals who make decisions about development in the coastal zone" (2009, p. 2)—perhaps in what we could label applied risk perception and spatial location. Meanwhile, Dunlap, and McCright (2008) considered climate change knowledge from a partisan perspective—"nowhere is the partisan gap on environmental issues more apparent than on climate change" was their overarching conclusion (p. 27). Heath and Gifford (2006) took free-market ideology and environmental apathy into consideration in their study about beliefs and perceived knowledge related to climate change.

In addition to the above studies that are strongly focused on select measures of knowledge there have recently been large-scale studies from major polling organizations and prominent universities. While these larger studies tend toward awareness/opinion polls, they do contain some elements of their study population's knowledge of climate change and are thus noteworthy here. Pugliese and Lyons (2010) reported on a Gallup poll of over 1,000 Australian adults who are reported to have the highest awareness of climate change in the world. In contrast to the Gallop poll, the Pew Research Center for the People and the Press conducted a large-scale, 1,500 adult survey (2009) and reported declining perceptions of anthropomorphic climate change. However, what is likely the largest (N=2,030 US adults) and most comprehensive study of knowledge (81 items) of climate change comes from the Yale Project on Climate Change Communication (Leiserowitz, Smith, & Marlon, 2010) that grades participants on 15 scales. Incidentally, only 8% of the respondents, representative of the United States' population, scored an A/B (80% and above) on climate change knowledge.

In the development of the Climate Stewardship Survey (CSS) presented here, we considered these surveys in light of our overall project's goal and modified knowledge and perception scale components, as well as informed our item creation in order to develop a customized instrument that combines various aspects of the previously noted instruments and aids us in learning what is lacking in our informal and formal learning environments in the Southeastern United States. This paper outlines the stages of development of the CSS, along with the reliability and validity descriptions of the new instrument with a pilot population.

Method

Data Collection

The survey sample was a non-probability sample of convenience drawn from voluntary participants predominantly associated with secondary and post-secondary environmental and geographic education in the southeastern United States. The survey instrument development described below, the Climate Stewardship Survey (CSS), was available on the World Wide Web through a survey development platform that allows for organized survey posting, data collection, and data download as approved by our Institutional Review Board. The sample of respondents consisted of 122 students and teachers peripherally associated with the Climate Literacy Partnership in the Southeast (CLiPSE). Of the respondents, 1 was from Alabama, 26 were from Arkansas, 1 from the District of Columbia, 41 from Louisiana, 1 from Mississippi, 1 from New York,

1 from South Carolina, 7 from Tennessee, and 43 from Texas. Of this sample population 62% reported their occupation as educator, 16% were students, and the remaining 22% represented administrators, scientists, unemployed, and other. The majority were female (67%), White (91%), Christian (75%), and of independent political party affiliation (43%).

This non-probability sample's data was not used to compare responses or considered as representative, rather, it was used to aid in investigating the reliability and validity of the CSS, to reduce the number of items in the pilot survey, to solicit feedback from a sample of respondents, and to determine how much time was required to complete the survey in order to finalize the instrument into a new instrument from which we could utilize for a larger-scale study.

Stages of Development of the Climate Stewardship Survey (CSS)

The development of the CSS used a well established three-stage approach following Fraser (1986) and others (Jegede, Fraser, & Fisher, 1998; Walker, 2010; Walker, & Fraser, 2005) for developing social perception survey instruments. The first stage involved identification of salient scales to determine knowledge and perception dimensions related to climate change. Stage 2 involved developing and field-testing items within each of the knowledge and perception dimension scales. And, stage 3 required field-testing the items followed by scale/item analyses and validation procedures. Below are more detailed descriptions of the steps involved in each development stage.

Stage 1, the identification and development of salient scales, involved four steps. (1) The first step was a review of the literature related to environmental psychology and climate change investigations in order to identify key components previously deemed important by researchers and practitioners in terms of climate change knowledge and perception dimensions. Likewise, this search noted literature surrounding agnotology and how such research has been utilized in environmental psychology and climate change research or how it could be transferable to such. (2) The second step involved reviewing previously developed survey instruments for their knowledge and perception scales that might be modified for the CSS or to inform the development of scales for the CSS. (3) The third step entailed the classification of knowledge and perception scales to ensure adequate coverage of these two dimensions. (4) The final step in this stage required the development of a set of preliminary scales to be reviewed by a panel of experts. After review by three university climate scientists, one geoscientist, an economist, and a public policy professor, five scales were agreed upon, some having related sub-scales. The Knowledge Dimension scales/sub-scales were: (1) *Impacts of Climate Change*, (2) *Causes of Climate Change* (sub-scales of: Temperature, Contribution, Greenhouse Gases), and (3) *Misunderstandings about Climate Change* (sub-scales of: Climate vs. Weather, Misinformation). The Perception Dimension scales/sub-scales were: (4) *Issues* (sub-scales of: Importance, Informed About, Sources Of, Beliefs About), and (5) *Policy* (sub-scales of: Threats, Role, Environmental Quality, Priority).

Stage 2, writing individual items, required (1) modifying items from previously published surveys and (2) developing new items for each of the above five Knowledge and Perception Dimension scales. This stage also included (3) the development of demographic items, some of which are unique to this survey, such as religion, political party affiliation, and occupation, among others. The final step involved (4) moving the instrument to the World Wide Web platform/interface and running a pilot test of the online instrument to check for errors in layout, design, data retrieval, etc.

Stage 3, field testing and analyses, involved a two-step process of (1) field testing the draft instrument with a sample in order to collect responses for statistical analyses and participant feedback. Participants were asked to time themselves and report how long it took them to complete the instrument at the end of the survey and to face validate the items by offering any notations regarding spelling errors, items making sense, and other practical usage comments. The second step involved (2) exploratory factor analysis to identify items which removal might enhance the factor structure of the instrument, and analysis of internal consistency reliability to determine the extent to which items within a scale measure the same construct as other items within that same scale. These analyses were conducted in order to statistically refine the CSS scales and to provide reliability and validity of refined scales. Data were analyzed using Cronbach's alpha coefficient to measure internal consistency in terms of item intercorrelation. Items not associated above 0.45 within their a priori scale were removed and data were reanalyzed until all of the items with low item-scale correlations were removed and alpha coefficients were maximized.

Results

The development of the Climate Stewardship Survey (CSS) relied upon an *internal strategy* where only items with modest factor loading within their own scale and weak loading on other scales are kept. It also makes use of the *intuitive-rational strategy* whereby only those items with good internal consistency remain in the final instrument (Hase & Goldberg, 1967). Described here are the results by which the CSS was refined and its reliability and validity were determined.

Reliability

During the development of the CSS, each scale was analyzed for internal consistency. Table 1 presents the alpha reliability for each refined scale. Of the 14 scales/sub-scales three were removed due to low reliability (alpha < 0.50). These were the entire sub-scales of: Greenhouse Gases (α = 0.29), Climate vs. Weather (α = 0.38), and Beliefs (α = 0.49). Thus, 17 additional items were removed. The overall instrument reliability after the removal of poor items was α = 0.93.

Table 1.
Scale reliability using Cronbach's alpha coefficient

Dimension/Scale	Final Number of Items	Alpha Reliability
Knowledge Dimension		
Impacts of global climate change (K.I1)	11	0.85
Causes of global climate change - *Temperature* (K.C1)	6	0.87
Causes of global climate change – *Contribution* (K.C2)	7	0.71
Misunderstandings about global climate change – *Misinformation* (K.M2)	3	0.70
Perception Dimension		
Issue Perception – *Importance* (P.IP1)	3	0.51
Issue Perception – *Informed* (P.IP2)	4	0.92
Issue Perception – *Sources (Quantity)* (P.IP3)	9	0.80
Issue Perception – *Sources (Trust)* (P.IPx)	28	0.94
Policy Perception – *Role* (P.PP2)	5	0.82
Policy Perception – *Environmental Quality* (P.PP3)	3	0.81
Policy Perception – *Priority* (P.PP4)	5	0.89

N = 122.

Validity

Content validity was addressed in Stage 1 with a panel of experts, and in Stage 2 with a pilot test. We do not assume external validity, or the generalizability, of the results, as this was a test of the instrument itself with a non-representative sample. Construct validity was investigated through principal component factor analysis with varimax rotation, Kaiser normalization, and Eigenvalues greater than one. The aim of factor analysis is to determine the basic structure of a set of variables to determine how strongly items load on a priori scales. That is, it is a method to determine if an item within a given scale is measuring that scale. Only items with a factor loading of at least 0.45 with their own scale and less than 0.45 with all other scales were kept (see Appendix A).

Thirty-four "faulty" items were identified and removed. In addition to the loss of those 34 items the entire sub-scale of Threats under the Perception Dimension was lost due to low factor loading. Likewise, due to factor loadings, the Perceptions Dimension sub-scale of Sources in the Issues scale was split into Sources (Quantity) and Sources (Trust). In hindsight this is clearly due to the question stems that read: "How much have you learned about global warming from these sources?" (quantity of information) in one set, and "How much do you trust the following sources?" (trusting sources of information) in another set. In the end the total number of items in the refined scale was 84, down from the original 128.

Table 2 presents the dimensions, scales, and scale descriptions of the new Climate Stewardship Survey (CSS). The table also presents the original number of items tested in the pilot study and the number of items remaining after validity and reliability analyses.

Table 2
Climate Stewardship Survey (CSS)

Dimension	Scale	Scale Description	Original Items	Final Items
Knowledge	Impacts of global climate change	K.I1. Measures the extent to which the population has knowledge of the impacts of global climate change.	18	11
	Causes of global climate change	Measures the extent to which the population has knowledge of the causes of global climate change.		
		K.C1. Sub-scale: Temperature affect	9	6
		K.C2. Sub-scale: Contribution	9	7
		K.C3. Sub-scale: Greenhouse gases	6	0
	Misunderstandings about global climate change	Measures the extent to which the population has misunderstandings regarding global climate change.		
		K.M1. Sub-scale: Climate v. weather	6	0
		K.M2. Sub-scale: Misinfo	4	3
Perceptions	Issue perceptions	Measures the population's perceptions related to global climate change issues.		
		P.IP1. Sub-scale: Importance	5	3
		P.IP2. Sub-scale: Informed	4	4
		P.IP3. Sub-scale: Sources Quantity	41	9
		P.IPx. Sub-scale: Sources Trust		28
		P.IP4. Sub-scale: Beliefs	6	0

(Cont.)

Table 2 (Cont.)

Policy perceptions	Measures the population's perceptions related to governmental policies toward global climate change.		
	P.Po1. Sub-scale: Threats	7	0
	P.Po2. Sub-scale: Role	5	5
	P.Po3. Sub-scale: Env Quality	3	3
	P.Po4. Sub-scale: Priority	5	5

Discussion

This study has defined a new survey instrument, the Climate Stewardship Survey (CSS)(see Appendix B), that considers both the participant's knowledge related to global climate change and their perceptions of global climate change while also considering how they are informed to consider the agnotological aspects of the issues. Influenced by prior climate change-oriented environmental psychology instruments, the CSS was drafted and field tested with 128 items. Knowing that the original number of items had to be reduced in a methodical and statistically sound way, we eliminated 44 items due to either low factor loading or low internal consistency reliability using data from 122 pilot participants. With the refined 84-item CSS one now able to implement the new instrument to complete a study about what a population knows and does not know about climate change, how that knowledge has come about, and that population's perceptions toward climate change and to the extent each of these components exists. Researchers will be able to determine to a degree where, if any, agnogenesis (Bedford, 2010) exists and direct resources toward altering misconceptions where they exist through outreach and education in both formal and informal learning environments so that the constituents might become solution providers rather than passive (mis)information absorbers.

This study is admittedly limited by the number of field study participants. A significantly larger number of participants will be necessary to determine if the statistically weakest points of the new CSS will hold up in further studies—namely the weaker sub-scale of Importance in Issue Perceptions where the reliability of the scale was low (α = 0.51) and items with marginal factor loadings below 0.50. As with any sound survey research, reliability and validity will need to be considered with future populations under investigation. Likewise, the sub-scales with low numbers of items may need to be rolled into larger scales instead of sub-scales or additional items should be added in future studies.

Nonetheless, investigators using the CSS in future studies, with diligence, should be able to view climate change perceptions and knowledge in a finer grain than in some previous research. A finer grain where impacts, causes, and misunderstandings are important to global climate change knowledge study and perceptions related specifically toward climate change issues and policy are regarded as noteworthy. What is more, future studies could conceivably modify the CSS with additional scales to investigate associations between the CSS's five scales in two dimensions and any additional scales of specific interest to the researcher. Of particular interest too will be the investigation of associations between the scales of the CSS to find out what influence knowledge has on perceptions and what influence perceptions have on knowledge and where misconceptions and agnogenesis—global climate change disinformation—may fit into the larger scheme.

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Appendix A

Factor loadings for a refined 98-item version of the CSS.

Item	P.IPx	K.I1	K.C1	P.IP2	P.PP2	K.C2	P.IP3	P.PP3	P.PP4	K.M2	P.IP1
Impact 1		.645									
Impact 2		.756									
Impact 3		.744									
Impact 4		.483									
Impact 5		.521									
Impact 6		.653									
Impact 7		.510									
Impact 8		.552									
Impact 9		.561									
Impact 10		.587									
Impact 11		.557									
Cause 12			.762								
Cause 13			.794								
Cause 14			.684								
Cause 15			.649								
Cause 16			.505								
Cause 17			.504								
Contrib 18						.456					
Contrib 19						.767					
Contrib 20						.788					
Contrib 21						.724					
Contrib 22						.537					
Contrib 23						.765					
Contrib 24						.696					
Misinfo 25										.708	
Misinfo 26										.636	
Misinfo 27										.488	
Import 28											.463
Import 29											.884
Import 30											.828
Inform 31				.768							
Inform 32				.864							
Inform 33				.876							
Inform 34				.827							
SourceQ 35							.686				
SourceQ 36							.539				
SourceQ 37							.699				
SourceQ 38							.690				
SourceQ 39							.781				
SourceQ 40							.738				
SourceQ 41							.761				
SourceQ 42							.455				
SourceQ 43							.508				
SourceT 44	.851										
SourceT 45	.814										
SourceT 46	.658										
SourceT 47	.768										
SourceT 48	.776										
SourceT 49	.661										
SourceT 50	.818										

SourceT 51	.801									
SourceT 52	.728									
SourceT 53	.556									
SourceT 54	.832									
SourceT 55	.867									
SourceT 56	.765									
SourceT 57	.781									
SourceT 58	.791									
SourceT 59	.632									
SourceT 60	.619									
SourceT 61	.599									
SourceT 62	.759									
SourceT 63	.734									
SourceT 64	.560									
SourceT 65	.764									
SourceT 66	.815									
SourceT 67	.700									
SourceT 68	.826									
SourceT 69	.815									
SourceT 70	.848									
SourceT 71	.724									
Role 72				.809						
Role 73				.827						
Role 74				.695						
Role 75				.618						
Role 76				.768						
EnvQual 77							.782			
EnvQual 78							.907			
EnvQual 79							.749			
Priority 80								.859		
Priority 81								.872		
Priority 82								.846		
Priority 83								.699		
Priority 84								.825		
% Variance	14.28	14.21	7.40	4.84	4.39	4.39	4.05	3.71	3.28	2.88	2.71

N=122; Principal component extraction; Varimax rotation with Kaiser normalization. Factor loadings smaller than 0.45 have been omitted. Sub-scales with poor reliability have been omitted.

Appendix B

Climate Stewardship Survey (CSS)
This appendix presents the scales and sub-scales, the items within each scale/sub-scale, the mean, the standard deviation, and variance of each scale/sub-scale of the new CSS.

Knowledge Scales	Scale Description	Items	Mean	*sd*	*Var*
Impacts of global climate change	K.I1. Measures the extent to which the population has knowledge of the impacts of global climate change. Response Scale: *4 definitely true* *3 probably true* *2 probably false* *1 definitely false*	A warming of the Earth can cause… 1. Disruptions in agriculture 2. Changes in animal migration patterns 3. Changes in regional environments 4. More UV radiation 5. An increase in the size of the ozone hole 6. Sea level rise 7. Glaciers to melt 8. Arctic ice to melt 9. Coral reef die off 10. Flooding of New York City 11. Increased homeland security threats	3.36	0.44	0.19
Causes of global climate change	Measures the extent to which the population has knowledge of the causes of global climate change.				
	K.C1. Sub-scale: Temperature affect *4 always true* *3 sometimes true* *2 seldom false* *1 never false*	To what extent does each of the following affect the Earth's temperature? 12. Volcanic eruptions. 13. Dust in the atmosphere. 14. Clouds. 15. Carbon dioxide. 16. Greenhouse gases. 17. Methane.	3.32	0.21	0.05
	K.C2. Sub-scale: Contribution *4 definitely true* *3 probably true* *2 probably false* *1 definitely false*	Which of these contribute to global warming? 18. Cows. 19. Automobiles/trucks. 20. Deforestation. 21. Burning fossil fuels for electricity. 22. The hole in the ozone layer. 23. Chlorofluorocarbons (CFC) 24. Greenhouse gases influence the Earth's temperature.	2.99	0.85	0.72
Misunderstandings about global climate change	Measures the extent to which the population has misunderstandings regarding global climate change.				

	K.M2. Sub-scale: Misinformation *4 definitely true* *3 probably true* *2 probably false* *1 definitely false*	25. The Earth is cooling, not warming. 26. Global warming is more beneficial than harmful. 27. Global warming is natural, not human caused.	1.87	0.21	0.04
Perception Scales	**Scale Description**	**Items**	**Mean**	***sd***	***Var***
Issue perceptions	Measures the population's perceptions related to global climate change issues.				
	P.IP1. Sub-scale: Importance *4 very* *3 somewhat* *2 rarely* *1 not at all*	28. How concerned are you about global warming? 29. How important is saving money on home energy costs to you? 30. How important is saving money on automobile fuel to you?	3.70	0.26	0.07
	P.IP2. Sub-scale: Informed *4 very* *3 somewhat* *2 rarely* *1 not at all*	How well informed are you about... 31. How the Earth's climate system works? 32. Causes of global warming? 33. The consequences of global warming? 34. Methods to reduce global warming?	3.13	0.05	0.00
	IP3. Sub-scale: Sources (Quantity) *4 very much* *3 some* *2 a little* *1 not at all*	How much have you learned about global warming from these sources? 35. Television 36. Internet 37. Books 38. Magazines 39. Newspapers 40. Family 41. Friends 42. Zoos, museums, aquariums 43. Government	2.44	0.31	0.10
	P.IPx. Sub-scale: Sources (Trust) *4 very much* *3 some* *2 a little* *1 not at all*	How much do you trust the following sources of information about global warming? 44. The Federal Government 45. The State Government 46. Local Government 47. President Obama 48. Federal elected politicians 49. Republican officials 50. Democratic officials 51. Tea Party officials	2.43	0.58	0.33

		52. Libertarian party officials 53. Green Party officials 54. National Oceanic and Atmospheric Administration (NOAA) 55. National Science Foundation (NSF) 56. Environmental Protection Agency (EPA) 57. National Aeronautics and Space Administration (NASA) 58. Intergovernmental Panel on Climate Change (IPCC) 59. University scientists 60. Government scientists 61. FOX News 62. MSNBC News 63. CNN News 64. Weather channel 65. Local TV news 66. Cable TV news 67. Church, temple, or synagogue officials 68. Focus on the Family 69. Family Research Council 70. Cornwall Alliance for the Stewardship of Creation 71. School teachers			
Policy perceptions	Measures the population's perceptions related to governmental policies toward global climate change.				
	P.PP2. Sub-scale: Role *4 significant* *3 somewhat* *2 rarely* *1 not at all*	How much of a role should… 72. Governments take in addressing global warming? 73. Businesses take in addressing global warming? 74. Courts take in addressing global warming? 75. Religious organizations in addressing global warming? 76. You take in addressing global warming?	3.50	0.42	0.18

	P.PP3. Sub-scale: Env Quality *4 excellent* *3 good* *2 fair* *1 poor*	Please rate the overall quality of the environment… 77. In this country today 78. In 10 years if we stay on the same track 79. In 50 years if we stay on the same track	2.23	0.45	0.20
	P.PP4. Sub-scale: Priority *4 significant priority* *3 somewhat of a priority* *2 low priority* *1 not a priority*	Please rate the following by priority… 80. America's environmental health 81. Protection of the nation's environment 82. Protection of the Earth's environment 83. America's economic health 84. America's energy security	3.80	0.71	0.01

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RESEARCH ARTICLE

İklim Değişikliği Bilgi ve Algısını Ölçmek için Bir Ölçme Aracının Geliştirilmesi ve Güvenirliği: İklim Yönetim Anketi (İYÖ)

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Özet

İklim Yönetim Anketi (İYÖ), katılımcıların güvenli bilgi kaynaklarını da göz önüne alarak küresel iklim değişikliği hakkındaki bilgisini ve algısını ölçmek amacıyla geliştirilmiştir. İYÖ üç aşamalı bir yaklaşımla geliştirilmiştir: belirgin kıstasların geliştirilmesi, maddelerin yazımı, alanın test edilmesi ve analiz. Yapı geçerliği ve alfa güvenilirlik düzeyi 122 maddelik test üzerinden yürütülmüş ve tam 84 maddelik bir İYÖ üretilmiştir. Alan testi yapılmış İYÖ beş boyut içerir: (1) İklim değişikliğinin etkileri, (2) iklim değişikliğinin nedenleri, (3) iklim değişikliği ile ilgili yanlış anlamalar (4) sorunlar ve (5) politika. Oluşturulan ölçme aracında bilgi boyutunda dört, algı boyutunda yedi alt boyut mevcuttur. İYÖ potansiyel katılımcıların özellikle iklim değişikliği ve buna yönelik politikaları, iklim değişikliğinin etkileri, nedenleri ve yanlış anlamaları ölçmek amacıyla yapılan çalışmalarda kullanılabilir.

Anahtar Kelimeler: İklim yönetim anketi, İYÖ, iklim değişikliği bilgisi ve algısı

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RESEARCH ARTICLE

Transforming Environmental Attitudes and Behaviours through Eco-spirituality and Religion

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Abstract

Incorporating spirituality and religious themes in environmental education is a way to link learners to their meaning systems. Research has shown that incorporation of a spiritual element in education provides a way for students to have authentic learning experiences and make meaning of the knowledge they acquire in the classroom. This mixed methods study examined the environmental attitudes, knowledge and actions of students in an introductory environmental science course with a spiritually infused curriculum at a community college. The quantitative data was collected from students in a survey of environmental attitudes, knowledge, and actions. Qualitative studies were conducted using a focus group to complement the quantitative data. Environmental education increases knowledge and awareness about earth's environment and teaches skills that lead to action that will ensure stewardship of all aspects of earth's environment. Integration of spirituality and religious traditions in environmental education offers an alternative approach in curriculum design that encourages learners' environmental attitudes and behaviors to be transformed.

Keywords: Environmental education, environmental attitudes, transformative learning theory, eco-spirituality, environmental behaviours

Introduction

The purpose of environmental education (EE) is to increase knowledge and awareness about earth's environment and teach skills that lead to actions that will ensure its protection (Withgott & Brennan, 2008). Traditional theories in the field of EE have suggested that teachers can foster changes in behavior by making students more knowledgeable. Research in the area of environmental behavior does not endorse that model, suggesting instead there are a variety of variables that influence behavior (Hungerford & Volk, 1990).

Developing methodologies that encourage students to critically examine their values is a challenge to environmental educators in the United States. Existing American practices promote overconsumption and subsequently resource degradation. Environmental educators integrate teaching strategies that encourage students to critically examine and

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reflect upon their current attitudes and behaviors and encourage transformed attitudes that prove more justified to guide sustainable actions.

Incorporation of spirituality in the higher educational setting provides an additional way for students to construct knowledge, make meaning of experiences, and move toward authenticity, all contributing to transformation. For religious students, activities that contain spiritual components allow students to connect to their established practices. For students who are spiritual, but not affiliated with an organized religious group, these activities can serve as the inspiration for students to critically examine their existing environmental attitudes, question their assumption and beliefs, and through reflection and discourse, transform their view of their place, responsibility, and importance in the natural world.

The goal of environmental educators is to raise awareness about environmental issues and impart tools for realizing sustainable solutions. Mezirow's (1981, 1997, 1998, 2000) transformative learning theory is founded on the premise that values and beliefs change as taken for granted beliefs and opinions are critically examined and reflected upon and new, inclusive, and authentic beliefs are formed. In the environmental science classroom, transformation can be evidenced by improved environmental attitudes, intents, and actions.

Many learners increase their knowledge of environmental science, but do not change their personal actions to reflect a more sustainable lifestyle. The integration of spirituality in adult education has been successful in promoting authentic learning experiences and in helping students make meaning of knowledge that is gained in the classroom (Tisdell, 2003; Tolliver & Tisdell, 2006). Haluza-Delay (2000) suggested that educators who "ignore the spiritual side miss essential avenues for personal and social change" (p. 149). It is important to analyze the effectiveness of adding a spiritual dimension to environmental education to determine what teaching methodologies are the most successful at promoting transformation and ultimately behavior change. Knowledge of these teaching methods will enable educators to incorporate useful strategies to facilitate transformative learning.

Transformative learning was developed by Jack Mezirow (2000) as a constructivist learning theory in 1978. He defined transformative learning as a "process by which we transform our taken-for-granted frames of reference to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action" (pp. 7-8). He stated the steps of transformative learning as the disorienting dilemma, critical reflection, reflective discourse, reflective action and perspective transformation. Transformation begins with a disorienting dilemma or event that causes an individual to question their assumptions or long held beliefs. Once the individual is faced with this event, critical reflection can take place. This is a solitary, private assessment performed by the individual to identify their long held assumptions and reflect upon their validity. Critical discourse then follows. The potential result of these events is perspective transformation. Mezirow (1997) described this as a change in a frame of reference. These frames of reference are described as "associations, concepts, values, feelings, [and] conditioned responses" (p. 5).

Current research in transformative learning theory is focused on methodology that can be implemented to encourage perspective transformations in learners. Mezirow (1997) suggested that adult educators create a classroom environment that is learner-centered, participatory, and interactive. Collaboration and critical assessment should be encouraged to explore real-life situations and problems in small group settings. Learners should be encouraged to use their own life experiences to assess and justify new

knowledge through learning contracts, case studies, role play, and classroom simulations. Adult learners should also be moving toward autonomy, in which the learner decreases his or her dependence on the educator and develops their own assumptions. In Taylor's (2007) review of literature he found that most studies suggest "providing students with learning experiences that are direct, personally engaging and stimulate reflection" (p. 182). Active learning, portfolios, and journaling are also powerful tools to promote transformation.

Tolliver and Tisdell (2006) suggested that learning is more likely to be transformative if it permeates one's whole self. This aspect of education includes the spiritual component of the individual. Much of Tisdell's research described how to incorporate a spiritual aspect into higher education. She specifically related spirituality as a way to foster transformation and paradigm shifts.

This study incorporated spirituality to promote transformation in environmental education. A main goal of environmental education (EE) is to increase student awareness of environmental issues and how their individual actions can affect our world. In 1969 Dr. William Stapp offered a definition of EE that has historically been accepted. He stated that "environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help people solve these problems, and motivated to work toward their solution" (Stapp, 1969). This was at the beginning of the modern phase of environmental policy in the United States, just one year before President Nixon signed the Environmental Education Act, which defined EE as the "educational process dealing with man's relationship with his natural and manmade surroundings, and includes the relation of population, conservation, transportation, technology, and urban and regional planning to the total human environment" (P.L. 91-516, 1970). A fusion of definitions creates a model of EE that includes awareness and sensitivity to the environment, environmental knowledge and understanding, an attitude of concern for the environment, skills to help solve environmental problems, and actions that lead to improved environmental conditions.

The purpose of EE is to produce an environmentally responsible citizen. Hungerford and Volk (1990) described this citizen as one who has an awareness or sensitivity to the environment, a basic understanding of the environment, motivation to improve the environment, skills to solve environmental problems, and active involvement in working toward solutions. Their research described a complex mix of twelve major and minor variables that contribute to an individual's environmental behaviors. These variables are categorized as entry-level variables, ownership variables and empowerment variables. They also examined critical educational components that promote learner behaviors, such as: teaching environmentally significant ecological concepts, providing opportunities for learners to achieve environmental sensitivity, teaching analysis and citizenship skills, and increasing learners' expectancy of reinforcement for acting in responsible ways.

Hungerford and Volk's (1990) environmental behavior model has been used extensively as a guide for environmental educators. However, several religious and spiritual elements could "contribute to and complement the influence and interaction of these factors" (Hitzhusen, 2006). Like the spiritual elements discussed above may enhance transformative learning, Hitzhusen suggests several spiritual elements that might catalyze the influence of the educational variables that lead to environmental citizenship behavior, including awe and wonder/sense of sacred at God's creation, religiously reinforced attitudes, love of creation, environmental justice knowledge, embracing stewardship vocation, knowledge of moral and ethical tenets, religious commitment and sense of call, religious environmental activism, faith and hope, participation in God's work, moral imperatives, legacy of social action and ethical influence, and acting out of love. No one variable, be it awareness, ownership, or empowerment related, should be expected to

sufficiently influence the learning process to make the difference in attaining environmental education goal, but a responsible combination of factors is more likely to be successful, and spiritual elements might enhance that success.

The goal of any EE teacher, whether in K-12 settings, higher education or community education, is to foster development of the above mentioned components and ultimately encourage individuals to make changes in their personal actions and their society. Some studies even suggest that universities for all programs include a course in environmental science to foster an environmental conscience (Kose, Gencer, Gezer, Erol, & Bilien 2010). Incorporation of spirituality in the environmental education classroom has the potential to foster transformative learning in post-secondary and adult learners and could lead to changes in environmental attitudes and behaviors.

Methods

This study used a mixed methods design to investigate the impact of spirituality on environmental attitudes and actions. Mixed methods research allows the researcher to further investigate initial quantitative results using descriptive, detailed qualitative approaches so that one form of data supports the other (Creswell, 2008). By incorporating a combination of both methods, there is a higher probability that complete answers to research questions and appropriate inferences from the findings can be achieved.

Surveys are often used to determine an individual's environmental attitudes (Schindler, 1999; Humston & Ortiz-Barney, 2007). The survey instrument for this study was given to freshmen students in an introductory environmental science class using a pre- and post-intervention protocol connecting environmental issues, attitudes, action and knowledge with course content. The questions incorporated a variety of survey items regarding environmental knowledge, action, and attitudes. It also included the New Ecological Paradigm (NEP) survey items, which come from an established survey instrument used to measure anthropocentrism or eco-centrism (Dunlap, Van Liere, Mertig, & Jones, 2000). Initial quantitative data was collected from the survey instrument regarding environmental actions, environmental attitudes addressing the relationship between humans, creation, and a divine power, and environmental knowledge. The quantitative data was collected the first day of the semester and again during the last week of the semester.

A focus group was used to collect qualitative data to complement the quantitative findings. Interview questions were designed following the procedure described by Krueger (1998) with a series of carefully planned opening, introductory, transitional, and key questions that were given to two groups of 12 students each. (Sample questions included: Has the course helped you gain knowledge about environmental behaviors? What actions have you changed in your daily life? Do you believe living an environmentally conscious lifestyle is a moral directive? Have your experiences in class broadened your perspectives? Please provide an example. Please comment on the spirituality portion of this course.)

The survey and focus group findings were used to determine the effect of a spiritual component in an environmental science class. Comparison of test group results with the control results determined if there was a significant difference between the class with an infused spiritual component and the class that is taught without those specified activities.

The control and experimental groups were given an identical syllabus outlining the chapters to be covered from the text. The control group completed all course components without any special assignments or discussions related to spirituality. Student activities in the control course included end of chapter questions and chapter content quizzes. The experimental group addressed the same course components with incorporation of special assignments, activities, discussions, and lectures with a spiritual component. One key component of the experimental class was that guided discussion covering all content

focused on the spiritual nature of the students' relationship with the environment. Also, the instructor shared personal experiences related to spirituality and environmental concerns. Both groups were administered the pre- and post-survey however the experimental groups participated in a focus group at the end of the semester. Significant improvements in environmental attitudes and actions were interpreted as transformation.

123 students completed the survey (*N* = 123). In the control group there were 36 students that took the pre-survey and 22 students that took the post survey. In the experimental group there were 34 students that took the pre survey and 31 that took the post survey. In the experimental group 24 students participated in the focus group at the end of the semester.

Description of Participants

The survey collected demographic data from all participants including age, sex, religious affiliation, frequency of religious meeting attendance, denomination (if applicable) and political orientation. These demographic variables have been found in the literature to have an impact on environmental attitudes and behaviors. Table 1 summarizes the findings.

Table 1.
Participant Demographic Summary

Group	Control Group		Experimental Group	
	Pre-survey	Post-survey	Pre-survey	Post-survey
N	36	22	34	31
Average Age	19	19	19	20
Males	12	5	24	23
Females	24	17	10	8
Religious Affiliation				
Protestant Christian	32	22	23	19
Catholic Christian	0	0	2	5
Hindu	0	0	1	0
No specific religion, but spiritual	2	0	6	5
No specific religion, not spiritually inclined	1	0	9	2

The Student Survey of Environmental Attitudes, Knowledge, and Behaviors was the instrument used to collect all quantitative data. The survey was given to the control and experimental group the first day of class and again the last week of class. The importance of giving the pre-survey on the first day of class ensured that all responses were based on the students' knowledge, attitudes, and behaviors prior to any exposure to course content. This survey was a collection of four separate survey sets that included 8 eco-spirituality items, 15 NEP items, 10 general environmental knowledge questions, and 12 environmental behavior items. Items related to environmental attitudes and actions were presented on a 5-point Likert-type scale. Attitudes were evaluated by the choices strongly agree, somewhat agree, unsure, somewhat disagree, or strongly disagree.

Results and Discussions

Quantitative Results: General Findings

Summative scales were used to obtain three separate scores for each student: an NEP score, an eco-spirituality score, and an environmental behavior score. Reliability of the scaled items was determined using Cronbach's Alpha. The NEP was .744, eco-spirituality .684, and environmental behavior, .770. The results showed that there was an increase in all areas except for environmental knowledge in the experimental group. The summary of mean scores for each group for four selected variables is presented in Table 2.

Table 2.
Mean Scores for Survey Items: Environmental Behaviors, NEP, Eco-spiritual Attitudes and Knowledge

Group	Environmental Behaviors (Range: 12-60)	NEP (Range 15-75)	Eco-spiritual Attitudes (Range 8-40)	Knowledge (Range 0-10)
Control Pre-survey (*N*=36)	35.22	48.88	28.47	4.03
Control Post-survey (*N*=22)	38.81	50.95	31.54	5.36
Experimental Pre-survey (*N*=34)	41.21	49.61	29.71	5.74
Experimental Post-survey (*N*=31)	43	54.25	31.67	5.65

Expected results for environmental behaviors, NEP, eco-spiritual attitudes and knowledge were that students in both courses would show measurable improvement. Also expected was that improvements in the experimental group would be larger than those of the control.

Environmental behavior

The environmental behavior scale was determined by the average score of 12 items. The range for the mean score was 12 to 60. As reported earlier, there was an increase in mean scores in the control and experimental group. Independent sample t-tests were conducted to determine if there was a significant difference between the groups. First, an independent samples t-test was conducted to compare the environmental behavior score of the control group and the experimental group on the pre-survey. This was done to determine if the two groups were significantly different before exposure to the course. There was a significant difference in the score for the control pre survey (M = 35.22, SD = 7.80) and the experimental pre survey (M = 41.21, SD = 7.55); t = -3.26, p = 0.002.

After completion of the course an independent samples t-test was conducted to compare the same score. There was a significant difference between the control post survey (M = 38.81, SD = 7.17) and the experimental post survey (M = 43, SD = 6.84); t = -2.15, p = 0.036. These results suggest that there was a significant difference between both groups at the beginning and end of the semester, with the experimental group consistently exhibiting a higher mean score for environmental behavior.

New Environmental Paradigm (NEP)

The NEP score was determined using a mean from the 15 item NEP survey. The range for the mean score was 15 to 65. There was also an increase in scores from the pre and post survey in both groups. An independent samples t-test was conducted to see if there was a difference between the groups at the start of the semester. Before exposure to the course, there was not a significant difference between the control (M = 48.89, SD = 8.09) and experimental (M = 49.62, SD = 7.95) group; t = -.38, p = 0.705. Although scores for both groups increased at the end of the semester, the differences were not significant between the control (M = 50.95, SD = 8.67) and the experimental group (M = 54.26, SD = 8.19); t = -1.41, p = -.164.

Eco-spiritual attitudes

The eco-spiritual attitudes scale consisted of 8 statements regarding humans, the environment and a divine power. The range of scores was from 8 to 40. Similar to environmental behavior and NEP, there was an increase in both groups when comparing the scores of the pre survey and post survey. An independent samples t-test was conducted to see if there was a difference between the groups at the start of the semester. Before exposure to the course, there was not a significant difference between the control (M = 28.47, SD = 6.51) and experimental (M = 29.71, SD = 6.95) group; t = -0.77, p = 0.446. Although scores for both groups increased at the end of the semester, the differences were not significant between the control (M = 31.55, SD = 3.56) and the experimental group (M = 31.68, SD = 6.03); t = -0.92, p = -0.927).

Environmental Knowledge

The environmental knowledge score was a mean of 10 questions. The range of scores was from 0 to 10. An independent samples t-test was conducted to see if there was a difference between the groups at the start of the semester. Before exposure to the course, there was a significant difference between the control (M = 4.03, SD = 1.62) and experimental (M = 5.74, SD = 1.56) group; t = -4.603, p = 0.000. The experimental group scored significantly higher at the beginning of the semester than the control group. At the end of the course, there was not a significant difference between the two group because the control group (M = 5.36, SD = 1.62) improved their scores and the experimental group's scores (M = 5.65, SD = 1.79) decreased. The t value for the post-survey was -0.585, with a significance of 0.561.

Qualitative Results: General Findings

The experimental group was divided into two groups of 12 students to participate in a final focus group. Two days at the end of the semester were selected to conduct the focus group. These interviews were held during regular class times; however, only those in the selected focus group met for that day. Interview questions were designed following the procedure described by Krueger (1998) with a series of carefully planned opening, introductory, transitional, and key questions. Sessions were audio-taped, transcribed, and subjected to in-depth thematic analysis to identify the significant themes that emerged from the data.

There were four major themes that emerged from the qualitative data. The first was reported behavior changes in the students based on knowledge acquired in the classroom. Another theme that emerged was the students' perception that there was a general lack of awareness of the public regarding environmental issues. This lack of awareness was also evident in the third theme to emerge, the spiritual mandate for environmental protection. Students reported that they believed there was a spiritual mandate for environmental responsibility, but they had never thought about it before this

class. The last theme to emerge was how personal experiences of the instructor inspired them in the classroom and in their personal life.

Analysis of Research Questions

The first research question was: Does the insertion of curricula oriented to eco-spiritual beliefs in the experimental group significantly alter students' environmental attitudes (NEP and eco-spiritual beliefs), environmental knowledge, or environmental behaviors when compared to the control class, thus exhibiting transformation? Based on the survey results, means for both the experimental and control classes increased in the environmental attitude scales and behavior scale. The knowledge score increased in the control class, but not in the experimental class.

There was a significant difference between the control group and the experimental group in the post-survey when analyzing environmental behaviors. However, there was a significant difference between the two groups at the beginning of the semester (t = -3.26, p = 0.002) with the experimental group scoring 9.9% higher on the behavior scale than the control group; therefore, it is not possible to determine if the post survey difference was from the spiritually infused curriculum or because the experimental group came into the class practicing more pro-environmental behaviors.

Although both groups showed a substantial increase in the attitude scales, during the post survey there was no significant difference between the two groups. There was a substantial increase in the experimental group concerning NEP, where the increase in the mean score was 6.2%, compared with 2.7% in the control group. The knowledge score increased in the control class over the course of the semester, but decreased in the experimental class.

The focus group data in the experimental class described the attitudes and behaviors of that group. When asked specifically about changes in their behaviors, students often responded positively that the knowledge they gained in the course encouraged them to change their behaviors. One student's comments show a transformation in their attitudes and behaviors after the course:

> A lot of us don't heat plastic anymore or anything like that. It's just—it's hard to think about all the little stuff we've changed now because it doesn't seem like we've done that much to change. It's just like, I'm not going to eat off plastic or I'm going to change out my light bulbs, just little stuff that makes a big difference.

Another student revealed how increased environmental knowledge helped foster behavior change: "We used [what we learned] to help change our habits the more we learned." One student's comment showed how discussions of eco-footprint and our moral obligation to reduce it affected their environmental attitude: "It makes you want to be more responsible for your part in the environment".

In response to a question regarding a spiritual mandate to protect the environment, one student responded: "People changed their mind about how we see things and realized we have to be more responsible. We are held accountable". This question also encouraged students to reflect on issues they had heard about in their churches. One student commented on the duality of stewardship: "Sometimes in churches you hear about stewardship and then you think, oh that's just giving money, but it's also taking care of what you've got that can't be replaced". When directly asked, one student admitted they were transformed by these ideas.

Q: Do you think spiritual beliefs should affect your attitudes about the environment?

A: They should, and like I said, up until this point I might not have really thought about that. So now they do because I'm trying.

Although the quantitative data showed improvements in the attitudes and behaviors during the course of the semester, there was no statistically significant difference between the control and the experimental group. The qualitative data expounded on the attitudes and behaviors of the students in the experimental group.

The second question was: To what extent are environmental attitudes or environmental knowledge predictive of pro-environmental behaviors? To determine the relationship between attitudes and behavior, Pearson product-moment correlations were computed between pro-environmental behaviors and environmental knowledge. Pearson *r* was also computed between pro-environmental behaviors and environmental attitudes (NEP and eco-spiritual). Prior to conducting correlation procedures, the scatterplot was examined and was suggestive of a linear relationship between the variables.

The correlation between knowledge and behavior was not significant ($p = 0.234$), with a Pearson Correlation of $r = 0.108$. It is assumed there is not a strong relationship between knowledge and behavior. However, a stronger correlation was found between attitudes and behavior.

The correlation between the NEP scale and pro-environmental behavior was significant ($p = 0.005$) with $r = 0.253$. Eco-spiritual attitudes had the highest correlation with behavior, with an $r = 0.257$ ($p = 0.004$). This relationship was still weak. Squaring the r value indicated that eco-spiritual attitudes and pro-environmental behaviors overlapped 6.6%. Table 3 summarizes the four-variable bivariate correlations.

Table 3
Pearson Correlation Among Knowledge, Attitude, and Behaviors

	Environmental Behaviors	NEP	Eco-spiritual Attitudes	Knowledge
Environmental Behaviors	1	.253**	.257**	.108
NEP	.253**	1	.259**	.323**
Eco-spiritual Attitudes	.257**	.259**	1	.028
Knowledge	.108	.323**	.028	1

**Correlation is significant at the 0.01 level

The third research question was: What role do socio-demographic factors play in the relationship between environmental beliefs and behaviors? The literature has shown two factors that strongly affect environmentalism: political ideology and religiosity. These are the two demographic factors that were analyzed. In order to determine the effect of these variables on environmental attitudes and behaviors, a partial correlation between attitudes and behavior while controlling for political ideology and religious service attendance was calculated. Table 4 summarizes the results the partial correlation while controlling for religious service attendance.

Table 4
Pearson Partial Correlation Among Attitude and Behaviors, Controlling for Religious Service Attendance

	Environmental Behaviors	NEP	Eco-spiritual Attitudes
Environmental Behaviors	1	.261**	.280**
NEP	.261**	1	.272**
Eco-spiritual Attitudes	.280**	.272**	1

**Correlation is significant at the 0.01 level

When controlling for religious service attendance, there was a slight increase in the correlation between environmental attitudes and behavior. This suggests there may be a slight negative impact of religious service attendance on environmental attitudes and behavior, however the correlation is still weak.

When controlling for political view, the correlation became even weaker, suggesting that political ideology may have more of an impact than religious attendance. The correlations are still very weak, with the correlation between environmental behavior and eco-spiritual attitudes falling below a significant level. Table 5 summarizes these findings.

Table 5
Pearson Partial Correlation Among Attitude and Behaviors, Controlling for Political View

	Environmental Behaviors	NEP	Eco-spiritual Attitudes
Environmental Behaviors	1	.242**	.230
NEP	.242**	1	.248**
Eco-spiritual Attitudes	.230	.248**	1

**Correlation is significant at the 0.01 level

Emergent Themes

Thematic analysis involved the identification of themes through careful analysis of the focus group data. It involved recognition of recurrent topics within the data, where these themes became the categories for analysis. Oftentimes themes occur in the focus group that were not anticipated or expected. In this section two emergent themes will be discussed.

One emergent theme from the focus group results was the students' admitted lack of environmental awareness. In spite of no questions that addressed it, this topic had more comments than any others during the focus group. Not only did the students comment on their lack of environmental awareness, they extended this deficiency to the general public (ex: "Everybody really needs to take this because if you don't take the class you really don't know, you're not aware"). Their comments suggest that their environmental attitudes and behaviors were deficient due to lack of environmental awareness.

Another emergent theme from the focus group was the positive impact of the instructor's shared personal experiences. Jacobs (1998) stated that sharing personal experiences with students can help them "make sense of their own increasingly fragmented, partial, and unstable perceptions and practices and work toward creating more powerful understandings and actualizations of agency" (p. 222). The students commented that personal experiences helped them understand environmental principles.

Conclusions of Findings

This study examined course components of an introductory environmental science class to determine if (1) transformative learning occurred, as evidenced by improved environmental attitudes and actions and if (2) incorporation of a spiritual component positively contributed to personal transformation. Environmental attitudes, measured by the NEP and eco-spiritual attitude scale, and environmental behaviors improved in both the control and experimental class, indicative of transformation. The experimental class did not show statistically significant improvements over the control class on the attitude scales, although increases in the NEP score were notable at 6.2% (compared to 2.8% in the control group). The NEP is one of the most popular surveys used to assess pro-environmental opinions. High scores on the NEP scale should indicate a pro-ecological orientation that leads to pro-environmental beliefs and attitudes on a wide range of issues.

There was a significant difference between the environmental behaviors of the control and experimental class on the pre survey and post survey with the experimental class scoring higher each time. It is difficult to determine if the classroom curriculum or existing pro-environmental behaviors were responsible for the differences. Nonetheless, improvements occurred in all areas in both classes. When some participants realized their faith tradition did in fact promote environmental stewardship, their attitudes were transformed and that often resulted in behavioral change.

Ajzen and Fishbein's (2005) theory of reasoned action demonstrates a link between attitudes and behaviors. In this study, pro environmental attitudes were slightly predictive of pro environmental behaviors, although these correlations were weak. Attitudes have been found to be predictive of behavior in many fields, however these relationships are complex and dependent on many external factors that may not be known to the researcher. Controlling for religiosity and political orientation did not have a substantial impact on the correlation between attitudes and behaviors. For religiosity, this could be due to the homogeneity of the sample, in which 76% of the students identified themselves as Protestant Christians, many of which were regular attenders.

A major theme of the focus group was the students' admitted lack of environmental awareness. They often commented that they did not have certain pro-environmental attitudes or behaviors simply because they were not aware of fundamental environmental principles before taking this course. This is important to note as it relates to the first three steps of transformation in Mezirow's learning theory: the disorienting dilemma, self-examination, and critical assessment of assumptions. For some students, gaining knowledge about the environment and environmental problems was an awakening. While adolescence is a phase in which individuals learn to be critically reflective about others' beliefs and assumptions, adulthood provides an opportunity to questions one's own assumptions. It was evident that students in the course were challenged to redefine their ideas about living a sustainable lifestyle. In many cases this resulted not only in an elevated environmental consciousness, but the integration of this awareness into their daily activities.

The use of personal experiences of the instructor emerged as a key component of active and engaged learning by the students. Many participants commented that they were able to relate better to the information when it was presented in the context of "real life". It also

inspired the students to examine their own lives to see how environmental knowledge could impact their decisions. The transparency of the instructor helped reduce the distance between the student and instructor and challenged the established notions of the teacher as an infallible expert. Students were also encouraged to defy the passive acceptance of knowledge and make decisions based on the lived experiences of others. This is a core concept of Mezirow's transformative learning theory.

Modern environmental problems will never be effectively addressed until citizens fully grasp the necessity of a healthy environment. Declines in environmental awareness and concern show that the United States needs a new focus in the field of environmental education. Acquiring an environmental education in a setting that encourages critical reflection on the role of humans in the world and promotes a holistic connection to our planet has the potential to produce a citizenry that practices sustainability in every area of their lives. Transformative learning is a tool that has the capability to implement lifelong changes and paradigm shifts that promote environmental protection rather than apathy. The role of spirituality in such processes needs further study.

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RESEARCH ARTICLE

Maneviyat ve Din Yolu ile Çevresel Tutumların ve Davranışların Dönüşümü

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Özet

Çevre eğitimine maneviyat ve din temalarını dahil etmek öğrenenlerle anlamlandırma sistemleri arasında bağ kurmanın bir yoludur. Araştırma, manevi ögelerin eğitime dâhil edilmesinin öğrencilere gerçek öğrenme deneyimleri sağlamanın ve sınıfta öğrendikleri bilgiyi anlamlı hâle getirmenin bir yolu olduğunu göstermektedir. Karma yöntemle yapılan bu çalışma, içeriği manevi ögeler entegre edilmiş bir programla hazırlanmış olan çevre bilimine giriş dersine devam eden öğrencilerin çevre bilgisi, çevreye karşı tutum ve davranışlarını incelemektedir. Çalışmanın nicel verileri, çevreye karşı tutum, çevre bilgisi ve davranışlarını içeren bir anket yolu ile toplanmıştır. Nitel veriler ise nicel verileri tamamlayacak şekilde odak grup çalışmaları ile toplanmıştır. Çevre eğitimi, öğrencilerin çevre bilgisini ve çevre farkındalığını arttırmakta ve çevreye sahip çıkmalarını sağlayacak eylemleri ortaya çıkarıcak becerileri öğretmektedir. Maneviyatın ve dini geleneklerin çevre eğitimine dâhil edilmesi ise program tasarımında öğrencilerin çevreye karşı tutumlarını ve davranışlarını değiştirmelerini teşvik edecek alternaf bir yöntem sağlamaktadır.

Anahtar Kelimeler: Çevre eğitimi, çevreye karşı tutum, çevresel davranış, dönüşümsel öğrenme teorisi

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INSTRUCTIONAL PRACTICE

Bringing the Tools of Big Science to Bear on Local Environmental Challenges*

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Abstract

We describe an interactive collaborative environmental education project that makes advanced laboratory facilities at Brookhaven National Laboratory accessible for one-year or multi-year science projects for the high school level. Cyber-enabled Environmental Science (CEES) utilizes web conferencing software to bring multi-disciplinary, inquiry-based research opportunities to Districts who wish to participate. CEES serves as a model to show how students involved in distance learning and experimentation can engage in exciting, state-of-the-art research to that enhances their skills for future Science, Technology, Engineering, and Math (STEM) careers. High school research opportunities through CEES support all seven New York State Standards for mathematics, science and technology (MST), Common Core and 12 of the National Geography Standards.

Keywords: Education, science, environment, synchrotron, internet

Program Background

Brookhaven National Laboratory (BNL) has developed a high school research program in Cyber-enabled Environmental Science (CEES). Our mission is to develop individual expertise in basic and applied energy science, environmental science, science education, and workforce development to prepare students and teachers for the challenges of the 21st Century. The learning experiences of both students and teachers supported by this program are important in several ways. First, the program will increase awareness of the technologies, methodologies, and interdisciplinary nature of energy, environmental science, and research. Second, it will stimulate and maintain a diverse "pathway" to enhance the student's skills for future careers in science, technology, engineering, and mathematics (STEM). Finally, it will afford students interested in other careers such as industry, laws, government, and education

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a sound global outlook on environmental and energy problems we face as an international community.

CEES utilizes web-conferencing platforms to bring unique technology and research from the National Laboratories into the classroom. It is ideal for high-school courses since it encompasses a variety of science disciplines and technologies that integrate well with history, politics, and economics. High-school research opportunities through CEES promote scientific literacy and science as a process by offering access to science, regardless of age, gender, culture, or ethnic background, through collaboration with the National Laboratory as outlined in the National Science Education Standards. It also addresses twelve of the National Geography Standards.

Table 1.
Summary of interactions with schools and teachers at various locations. The color code identifies schools on Long Island, NY (green), New York City (pink), other states (blue), and foreign (yellow).

• Sayville	New School
• Islip	Kingsborough CC
• Bellport	Harbor School
• William Floyd	River Project
• Longwood	
• South Shore	Washington Math Science Technology Public Charter School, Washington, D.C.
• Westhampton	Southern U, New Orleans
• Syosset	
• Kings Park	
• Southampton	Pisa, Italy
• Patchogue	KFK, Budapest
• Comsewogue	MGIS, Ahmedabad, India
	Hyderabad, India
	Ste. Maxime, France
	Craponne, France

Not only has the CEES program been successful in the Long Island schools. But it has been favorably received by ones in Washington, DC, and New Orleans, LA. Importantly, while our program allowed local students to work with the equipment at Brookhaven, establishing it via the Internet allows students too young to work in experimental facilities to see research in progress and to talk directly to the scientists. This is an important advantage; the earlier we can engage students' interest in science, the more likely they will become scientists themselves. Furthermore, visiting the laboratory presents scheduling problems and time-consuming bus rides; learning via the Internet eliminates these drawbacks because we are able to confer directly with the people in the individual classrooms and so avoid this problem. In addition, using

the Internet also opens our researches to the world so that we can work with schools and teachers in Europe, Asia, and elsewhere.

As a first approach, we chose to study topics germane to ecosystems worldwide. One universal problem relates to the fate and transport of metals in site-specific ecosystems. The metal-related environmental problems menacing the tri-state region of New York, New Jersey, and Connecticut are similar to many urban areas around the world, not only to those sited in coastal areas, but to developments located on the banks of rivers, streams, and lakes. Thus, the concepts discussed here are modifiable and applicable to different types of environmental problems.

The goal of the study on which this topic is founded is to conduct a broad-scale-screening of heavy-metal uptake by mussels and oysters from local embayment's and tidal creeks since they are an excellent indicator of environmental conditions related to water quality and to toxic compounds circulating in the aquatic environment. Concomitant investigations of soils, sediments, water, and biota will aid in defining the fate and transport of metals in Long Island's ecosystems.

This topic is a natural for us since our location on Long Island places us in close proximity to four major estuaries: Long Island Sound, South Shore Estuary Reserve, Peconic Estuary, and the lower Hudson Estuary. Furthermore, heavily populated urban and suburban-regions surrounding these estuaries, exposing them to impacts from human activities.

Program Components

1. Recruiting Schools.

We recruited schools and teachers for the CEES through science-education programs run by BNL's Office of Educational Programs. The teachers, from varied backgrounds, teach courses with different objectives. The environmental field demands expertise and interest in all the STEM fields, and hence, effectively can engage teachers with different approaches to teaching.

2. Student Levels

Students of all ages and aptitude levels are interested in environmental topics. The CEES program offers mentoring and academic engagement to advanced placement students and to students with typical course loads. Web –based conferencing is an essential component of both interactions.

3. Site Selection

The sites investigated are chosen in collaborations between BNL's participants and the teachers. We try to arrange selections and topics covering experiments and collections that are convenient to the locations of individual schools, yet that are relevant to a broad understanding of the regional environment.

4. Students' Collection of Samples in the Field

Students who participated in this project gathered bivalves from their designated study sites and prepared them for laboratory analysis by separating tissue and shell. As they collected their biological samples they also collected sediments from the areas where the bivalves were anchored. Our field protocols and experiences support curriculum content and hands-on techniques that are useful in introducing course content covered in their earth science, biology, chemistry, physics, and environmental science classes. By collecting samples in the field, students are enabled and encouraged to take ownership of the project, so spiking their interest in the laboratory work and supporting

their drawing satisfying conclusions from examining their samples and discussing their views.

5. School Laboratory Work

Students handled the initial preparation of bivalve shells, sediments, and soft tissues themselves. Preparing the shells entailed washing them thoroughly with soapy water, while brushing them to eliminate mud and other surface deposits. Sediments and tissues were oven-dried at temperatures less than 30° C. The shells were reduced to a powder with a mortar and pestle, and pressed into disks a few mm thick with a high-pressure press at 34.5 MPa (5000 psi). Soft-tissue samples were prepared from homogenized whole bivalves, and in some cases, from individual organs. Hands-on preparation of samples is important; students learn about the geology of an area from working with the sediments, as well as gleaning the basics of biology and morphology, respectively, from identifying the bivalves themselves, and their internal organs. Instruction on weight measurement and microscopy is covered, as needed. Figure 2 shows laboratory work done at a high school.

6. Analysis of Samples at BNL's National Synchrotron Light Source

The big science tool we employ for this work is BNL's NSLS facility, http://www.nsls.bnl.gov The NSLS generates intense x-ray beams that serve for investigations on a micrometer-size scale. We used a specific x-ray technique called x-ray fluorescence in our studies. The technique is simple to explain. The incident x-rays interact with the atoms in the sample and cause them to emit secondary x-rays that are specific signatures for particular elements. The secondary x-rays are collected, and the displays show the number of X rays at particular energies. The energy identifies the element; the number of events is proportional to its concentration in the material tested.

To eliminate all risk to the experimenters, we conduct our experiment in a shielded enclosure. The system's major items are the focusing lenses to focus the x-ray beam to about 10 micrometers, moveable stages to position the sample in the beam, an x-ray detector, and video cameras to remotely view the sample and other equipment. Figure 3 shows the equipment inside the hutch. Computers sited in an open laboratory outside the hutch control the experiment.

Figure 1. High School students gathering a sediment core sample from a creek located close to the school (Left). Students from other schools carried out similar collection exercises (Right).

Figure 2. Students prepare samples for analysis at the NSLS at their school laboratories. Sediments collected by the students are shown at the left. A student preparing samples for analysis at the NSLS is shown on the right.

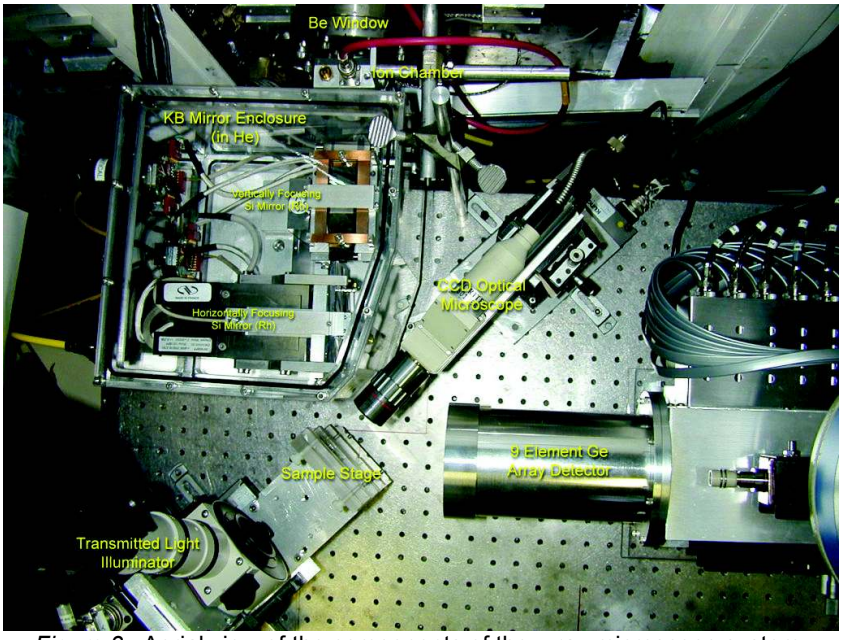

Figure 3. Aerial view of the components of the x-ray microscope system.

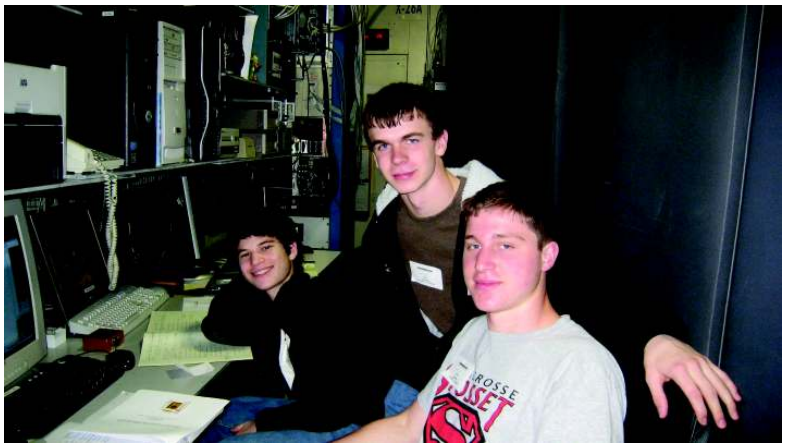

Figure 4. Students from Syosset High School at the NSLS are analyzing their samples at the NSLS.

7. Student Participation in NSLS Experiments

Students can come to the NLS and take control of experiments if they are over 16, and have qualified as users by taking the required web-based training courses. Students over 16 years of age also can attend as observers without becoming users. This system effectively overcomes the restrictions of time and distance. Web-based conferencing is an efficacious way to give virtual access to those under 16, to students too far away to make the trip, and to interact with small or large groups of students during classes scheduled for a particular time.

Many different web conferencing services are available for remote access:http://evo.caltech.edu/evoGate/index.jsp Skype (http://www.skype.com) Adobe Connect Now (https://acrobat.com/welcome.html#si=1), and http://research.seevogh.com/ (formerly http://evo.caltech.edu/evoGate/index.isp) are good examples that are free or low cost, but their features vary, and there might be a cyber-security issue depending on the individual school concerned. All three have proven very satisfactory for our work.

The most important features for CEES include the following: (a) Screen sharing so that participants can view samples at NSLS whilst capturing screen shots of the data output in real-time; (b) remote-control access wherein students can assume control of the desktop and take virtual tours through the NSLS, as well as manipulate the data from their classrooms; (c) video-conferencing for large- or small- group interactions; and. (d) audio options where using a microphone and speakers allow an entire class to interact directly with beam line scientists (Figures 5 and 6).

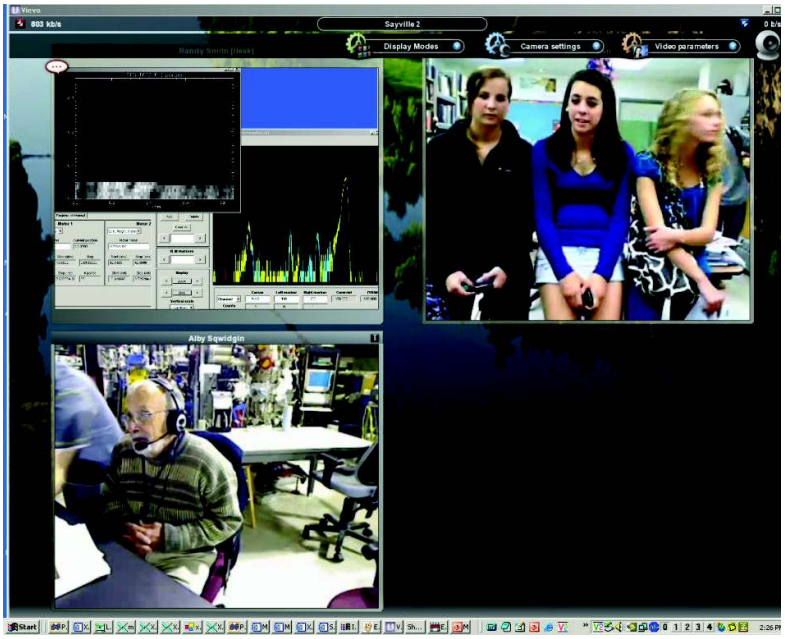

Figure 5a and 5b. Interactive remote conference between NSLS and Sayville High School Students. The group discusses the experimental data being acquired in real time on the upper left. The students can control the experiment from the classroom. The top photograph (5a) shows the computer screen seen by the participants and the bottom photograph shows the students and teacher at the high school (bottom) (5b).

Figure 5b.

Figure 6a and 6b. Internet conferencing with larger classes is shown at the William Floyd High School (top) and the Southampton High School (bottom).

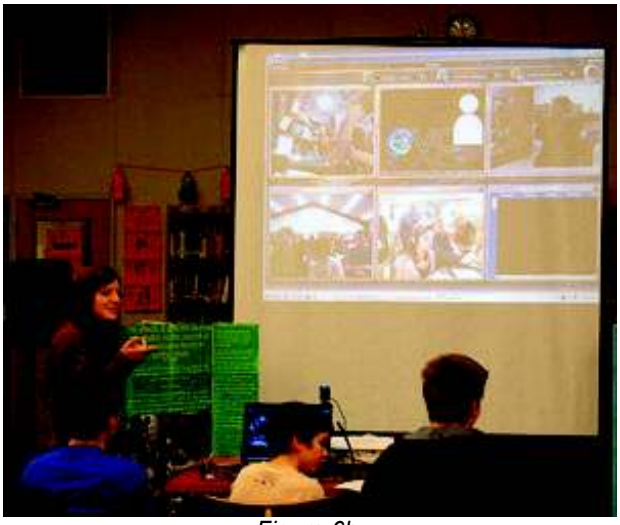

Figure 6b.

8. Initial Demonstrations at Sayville- and Riverhead-High Schools

Students from Sayville- and Riverhead-High Schools collected oysters and sediment samples from the Great South- and Peconic-Bays, Long Island, New York. They prepared the samples at their high school before analyzing them at the NSLS facility. Preparations included tissue, shell, and sediment as described in the Methods section. Samples of tissue, shell, and sediment were probed at the NSLS x-ray microprobes while students and teachers observed through the cyber-enabled remote access to the NSLS. The most valuable part of these sessions was when BNL scientists displayed and explained the real-time data to the participating students. Typically, this led to a discussion session between the scientists, students, and teachers from the different high schools. BNL scientists instructed students how to interpret the x-ray energy levels, and associated elemental maps. Students asked questions via a microphone, while viewing the data output through a videocam. This communication platform also enabled the scientists to familiarize students with the basic physics involved in synchrotron storage rings used to generate x-rays; there were some valuable discussions about the interaction of x-rays with matter in terms of the Bohr model of the atom. This gave the students the necessary background for analyzing and interpreting the data.

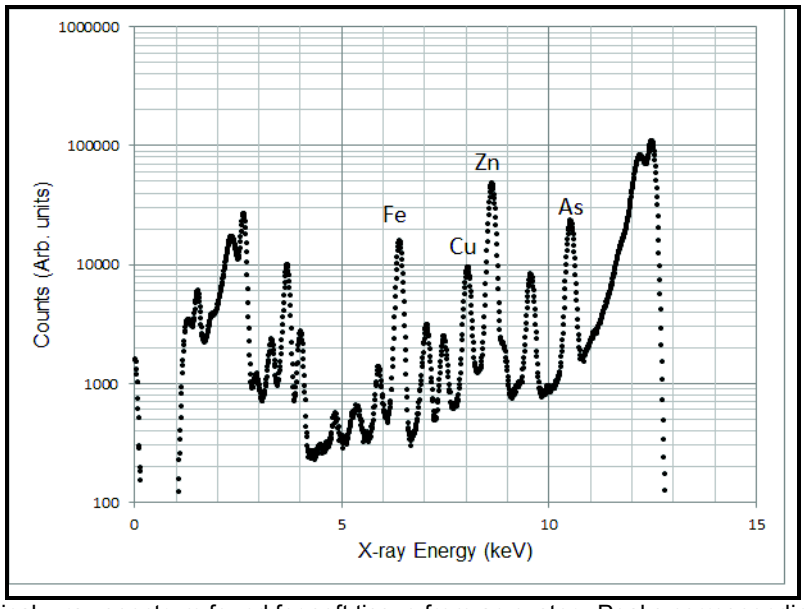

Figure 7. Typical x-ray spectrum found for soft tissue from an oyster. Peaks corresponding to detection of specific elements are labeled in the plot. The concentration of the element is proportional to the peak height.

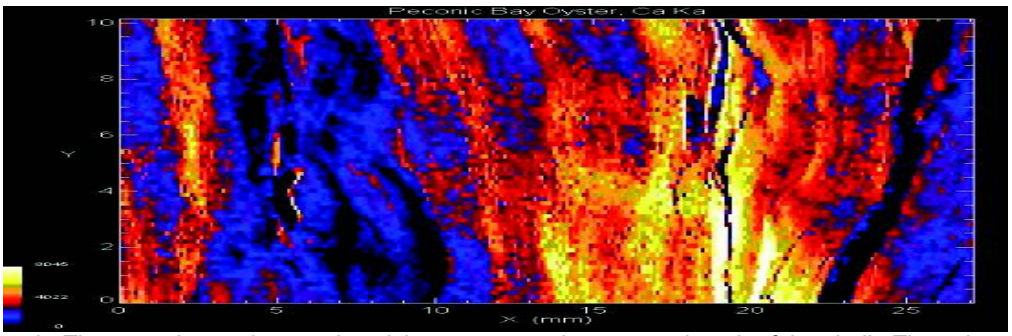

Figure 8. The map shows changes in calcium concentrations over a length of the shell. The color scale runs from black for the lowest concentration and white for the highest concentration.

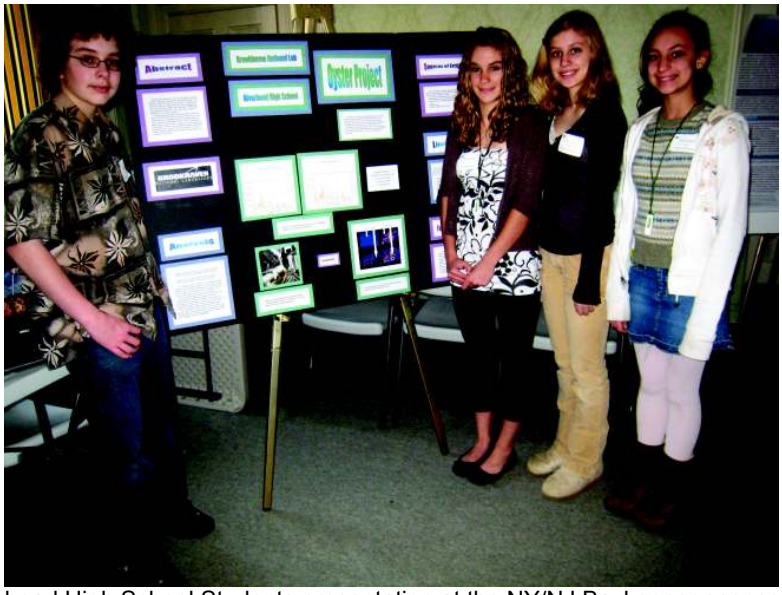

Figure 9. Riverhead High School Students presentation at the NY/NJ Baykeeper sponsored conference on "Restoring the Urban Oyster", held at Pershing Hall, Governors Island, New York, NY on April 24, 2009.

Preliminary Findings

The x-ray data obtained by the x-ray analysis yields the relative concentrations of each element by plotting a spectrum of events as a function of their energy. Figure 7 is a spectrum obtained from the soft tissue of an oyster taken in the Great South Bay. A striking result is the observation of arsenic, a very toxic element that probably reflects contamination from anthropogenic sources, such as fertilizers and pesticides. Students can analyze the data at different levels of sophistication to identify the elements and their concentrations beginning with the use of a ruler to measure peaks and positions on a plot of the data. A more refined method imports the data into a spreadsheet for manipulation. Finally, the most sophisticated one uses freeware to run software designed for the specific task.

Maps can also be made of elemental concentrations in selected areas of a shell. Figure 8 shows an example of changes in calcium (Ca) concentration in an oyster shell over time. This information is important and can relate the growth of the bivalve to environmental conditions in the marine environment. When conditions are optimal for growth, the Ca concentrations will peak. The map shows measurements made at many points over the shell's surface. The map covers a total area of the shell that was 27 mm in the horizontal and 10.0 mm in the vertical directions along the X-ray beam The horizontal distance covers about 1year in the life of the oyster, and the color scale reflects changes in the oyster's metabolism that dictates the changes in the Ca concentration in the shell over that period.

9. Assessment

Students were assessed through a grading rubric at various checkpoints throughout the year. Project assessments include literature searches, experimental design, final report, scholarly writing, PowerPoint presentation, poster board, and formal presentation at local-, regional-, and/or national-science competitions, as well as presentations at BNL.

As an example, Riverhead students presenting their project results at a conference are shown in Figure 9.

In conclusion, bivalves and their environment have proven an excellent interdisciplinary study model organism that captures the interest of the target spectrum of students, teachers, and scientists to foster inquiry-based science, while introducing the skills and technology to promote secondary students into STEM career paths. BNL's Office of Educational Programs (OEP) and Environmental Sciences Department thus have successfully demonstrated that they can bring the resources of BNL to students and teachers anywhere in the country (or world) with an Internet connection.

We have shown that:

1. Our program brought about a close relationship between high school teachers and students at different locations to investigate a topic of mutual interest. The result was a large database that can be used as a foundation for continuing investigations. The collective results make a contribution to management of particular environmental resources and make possible evaluation of multi-year changes in the environment.

2. Our project comprises three collaborating groups: teachers and students, BNL educators, and BNL scientists. Schools can get involved in the project by direct contact with either of the BNL components or through school-to-school connections. Teachers need to understand that the program content is flexible and can be adjusted to the situation in particular schools or to the needs of particular students. We have an open program and expect that schools will opt out or in as time goes on. We add schools through word-of-mouth contacts, participation in conferences and environmental projects, and through the core BNL Office of Education teacher and student programs.

3. We plan to develop similar programs based on other subjects and facilities at BNL. This can be done by networking with the teachers and BNL scientists. We want to have topics that are important from a scientific standpoint and are suitable for multi-year participation by teachers and schools.

4. Teachers should be aware that the Department of Energy operates 10 National Laboratories around the United States. All of them run education programs similar to the one in operation at BNL. Teachers need to be aggressive in working with them to develop new interactive programs.

This program significantly expanded the participation of high- school students and teachers at a large National Laboratory research facility. It removes many barriers to participating in research during the academic day, viz., economic (busing), safety, and time away from school (missed course work). Potential shortcomings of this project include the unreliability of the Internet and Internet connectivity. However, cyber infrastructure, and technical support continues to improve in the participating schools. We note that it is vital for teachers and technology administrators to become familiar with web-conferencing technology before they undertake cyber-enabled science experiments with students. Several students who were co-authors on a scientific, peer-reviewed paper on the work conducted in association with the Pilot Program[2] provided feedback about their experiences with CEES as follows:

Some typical student feedback about experiences with CEES, is outlined below:

Kala - grade 9- "I've seen a new world- the ability to work on this project is one of the most exciting things to happen at my school."

Alycia - grade 9- "I feel as though I am more in contact with the rest of the world."

Nina - grade 9- “I have never learned so much in such a short time.”

Andrew - grade 9- “Face to face contact with a scientist is much more valuable than reading a publication- EVO and our web cam has opened our classroom to web 2.0 and the rest of the world. We can travel great distances and never leave our classroom”

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Biographical statements

Scott Bronson is the manager of K-12 Programs for Brookhaven National Laboratory's (BNL) Office of Educational Programs (OEP). Before coming to BNL, Mr. Bronson was the Education Coordinator of Cold Spring Harbor Laboratory's Dolan DNA Learning Center. He has a strong background in developing and commercializing laboratory science, technology, engineering and mathematics (STEM) curriculum for middle school, high school, and undergraduate faculty and students. E-mail: sbronson@bnl.gov

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Maria Brown received a Master of Science in Environmental Science from Long Island University. She received a BS in Geology and a BA in Biology from CUNY – Queens College. She worked as an Environmental Scientist and Certified Professional Wetland Scientist for 10 years in local engineering and consulting firms before becoming a science teacher at Sayville High School in 1999. She is certified in general science, biology and Earth science (7-12), and has taught Advanced Placement Environmental Science for 8 years and Research in Science and Engineering for 5 years. E-mail: zostera2@gmail.com

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INSTRUCTIONAL PRACTICE

Yerel Çevre Sorunları ile Mücadele Etmek için "Büyük Bilim" Araçlarını Devreye Sokmak

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Özet

Bu çalışmada, Brookhaven Ulusal Laboratuvarı'nda bulunan gelişmiş laboratuar olanaklarını, bir ya da daha fazla yıl sürecek lise düzeyindeki bilim projeleri için erişilebilir kılan, etkileşimli ve işbirlikçi bir çevre eğitimi projesi açıklanmaktadır. Bilgisayar İçerikli Çevre Bilimi, (BİÇB) katılmak isteyen ilgililer için çok disiplinli araştırmaya dayalı fırsatları sağlamak için web tabanlı konferans yazılımı kullanır. BİÇB, uzaktan öğrenme ve deneyi heyecan verici bir şekilde bütünleştiren, öğrencilerin gelecekteki Bilim, Teknoloji, Mühendislik ve Matematik (BTMM) kariyer becerilerini geliştirmek için hizmet veren bir modeldir. BİÇB aracılığıyla yapılan lise araştırmaları, New York Eyalet Standartlarının matematik, fen ve teknoloji (MFT) alanındaki yedi ve Ulusal Coğrafya Standartları'nın 12'sini destekler.

Anahtar Kelimeler: Eğitim, bilim, çevre, senkrotron, Internet

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