TOP-EXPERTISE FOR EDUCATION IN SUSTAINABILITY

Innovative ICT-approaches to 'connect' students & experts

K.M. Brezet[1], J.C. Brezet[2]

[1]International Institute for Industrial Environmental Economics, Lund, Sweden
[2]Delft University of Technology, Faculty of Industrial Design Engineering, Landbergstraat 15, 2628CE, Delft, The Netherlands, j.c.brezet@tudelft.nl, +31 152782738.

Abstract

High schools are increasingly concerned about educating and engaging their students in sustainability issues. Consequently, curricula in many schools are being redesigned in order to focus upon these issues and their consequences. The project 'Scholen voor Duurzaamheid' (Schools for Sustainability, SvD), for example, is being used as a springboard in Dutch high schools to gain experience in Education for Sustainable Development (ESD).

This paper presents the outcomes of research conducted in the period January-September 2010. The objective of this research was to investigate how Information and Communication Technology (ICT)-tools can support the effective integration of experts' tacit knowledge into high-school sustainability projects, such as SvD. The main research method used within the performed study was *case research*, which involved literature reviews, interviews and direct in school observations.

The literature review examined the areas of ESD, experts' knowledge and ICT-tools. Underlying theoretical aspects of these three areas were connected through the construction of a conceptual model. This model consequently formed the basis for the creation of different propositions, which were used to focus and guide the empirical data gathering.

In order to gather empirical data, case studies were performed at high schools and ESD programmes working with ICT. Examination of these cases was designed to assess if the contributions of experts are considered to be valuable for the educational process, in which ways experts are contacted with the help of ICT and what kind of difficulties could arise through the use of ICT-tools.

The findings of the research formed the foundation for several recommendations for different actors that are involving, or may wish to involve experts and ICT in improving the effectivity of high school ESD education.

Keywords
ESD, experts, high schools, ICT, knowledge transfer

1. Introduction

The United Nations (UN) has been concerned with sustainable development for almost three decades. In 1983, the United Nations World Commission on Environment and Development (UNWCED) was created with the mandate to help societies becoming aware of and engaged in the crucial activities needed to make the transition to sustainability. Education, according to the UN, is an essential prerequisite. This focus has eventually led to the establishment of education referred to as ESD.

Important actors in this field include but are not limited to: non-governmental organizations (NGOs) that help to integrate ESD into the classroom, experts with extensive knowledge, the UN and its organizations, educators, administrators and parents. An example of one NGO involved in ESD in the Netherlands is 'IVN Natuur- en milieueducatie' (IVN). This organization has developed an advanced educational programme that is being introduced throughout the Netherlands.

Part of the educational programme is the 'Scholen voor Duurzaamheid' project. This project involves experts in the teaching process and delivers innovative ESD, a dynamic program and time saving for educators. ICT can help to achieve the project's goals. Students, for example, need to use different ICT facilities in order to get in touch with experts and to learn from their experience and knowledge. However, it is important to realize that experts possess different kinds of knowledge and difficulties can arise when such knowledge is integrated into the teaching processes of high schools. The research question presented in this paper, is therefore:

"How can ICT approaches support the integration of experts' knowledge into high-school sustainability (-ESD-) projects of NGOs?"

The scope and focus of the research was on the area of ICT and limited to the Dutch educational system and similar ones.

2. Methodology

The main research method used within the discussed study was *case research*, which involved literature reviews, interviews and direct in school observations. The reviews of the literature made it possible to create a conceptual model on the process of the utilization of ICT-tools and experts in facilitating high school students with valuable learning experiences. This model diagrammatically, includes the important parts and connections that were revealed within the literature. More specific and structured questions were created through the use of the model, which led to the creation of several propositions to guide the empirical data research. The performed empirical research subsequently consisted of two case studies conducted at different high schools and the examination of ESD programmes which include the use of ICT-tools and experts' knowledge or which are planning to integrate such an approach into their course.

3. The 'Scholen voor Duurzaamheid' project

In order to make the reader more acquainted with the structure and process of high-school sustainability projects such as the SvD project, a more thorough introduction of the project's content and approach is presented in this section.

The SvD project was introduced in the Netherlands by IVN; a Dutch NGO with the primary objective to contribute to a sustainable society by educationally involving people in nature and environmental surroundings. Communication, education and participation are primary means used by IVN in order to achieve the organization's objective. IVN was created in 1960 and now consists of both paid employees and volunteers (approximately 17.000), whose work leads to a broad range of products and services. The organization often collaborates with other, similar, organizations, such as educational institutions and governments (IVN, 2009).

Collaboration between IVN and Dutch high schools has led to the creation of the project-based initiative SvD. The SvD project, through involving adolescents in actual sustainability issues with the use of a solid educational approach, aims at strengthening the role and quality of SD education in Dutch high schools. The project also helps IVN to achieve its broader objective of contributing to a durable society by involving people in nature and environmental engagement. Between 2001 and 2008, the SvD project had reached 24.000 Dutch students (Van der Waal & Wals, 2009).

The overall objective of the SvD project is to provide students between the ages of 12 – 18 experience with actual, concrete societal problems, which need holistic, multi-disciplinary approaches to 'solve' them. Several different resources are provided to the students, such as the possibility to talk to and interview representatives of companies, organizations or the government. Experts are, in this way, directly involved in the teaching process and students are, in a significant manner brought into contact with these experts, by looking jointly for solutions to current societal challenges.

Figure 1 describes the different steps that are undertaken by students when taking part in the SvD project, with the research-focus indicated by the red lined box:

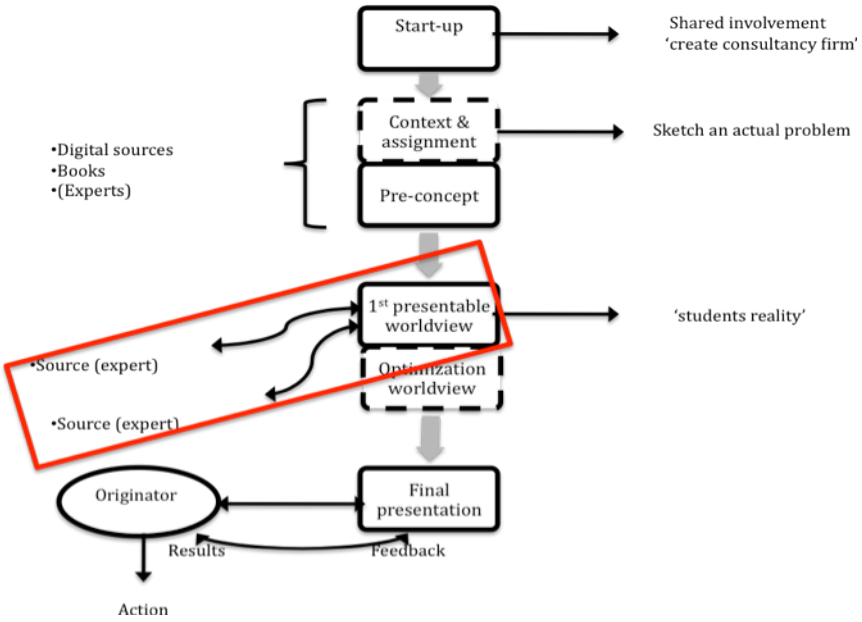

Figure 1: Steps within the SvD project (D. Teeling, personal communication, June 9, 2009)

Experts, according to IVN, can be classified into two major categories. The first category consists of persons who are employed by a government or company. The second category consists of persons who are working within a specific field of activity and possess a lot of specific knowledge about a certain topic (L. Blok, personal communication, August 31, 2009). IVN believes that the contribution of experts to the project has multiple advantages for the students and teaching process.

4. Literature review

To find preliminary answers for the research question, the literature review subsequently examined the areas of ESD, experts' knowledge and ICT-tools. The focus of this review was upon what scholars have written about ICT-tools that have an identified relevance when

experts' knowledge is integrated into the educational process. A short analysis of the main findings is given in this section.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasizes the importance of ESD for a world that can offer enough opportunities for a sustainable future. In order to reach this, UNESCO emphasizes the importance of the reorientation of formal education, schools and their policies towards ESD (UNESCO, 2005). Administrators, staff and students will have to cooperate with NGOs and companies in order to act as 'change agents for sustainability' (Huisingh, 2007). Moreover, several identified elements of ESD, such as knowledge, issues, skills, perspectives and values, will have to be kept in mind in order to achieve the desired educational outcomes.

Throughout the world, many approaches to ESD have been developed. The differences between changes in attitude and in behavior are two main distinctions that have been made in literature with respect to educational outcomes. Environmental approaches also attach value to such changes and envision the inclusion of experts in the educational process in order to reach them. Figure 2 combines the elements of SD education and its expected outcomes:

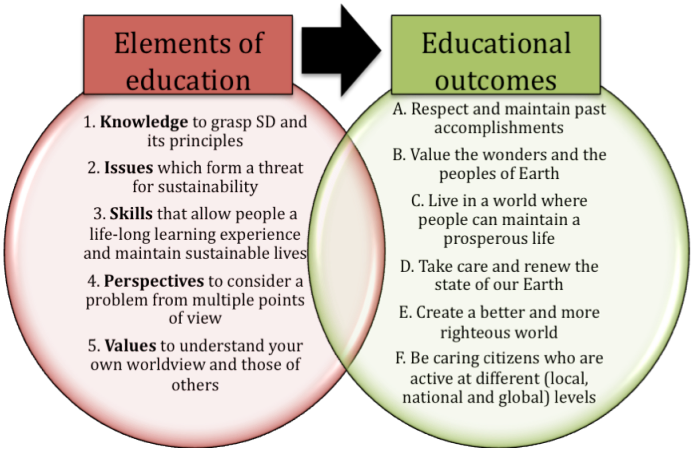

Figure 2: Elements of education and educational outcomes (Training Guideline, n.d.)

Scholars have described several ESD approaches which include contributions of experts (e.g. Flint, McCarter, & Bonniwell, 2000 and Domask, 2007). From one single expert to a whole community including a range of experts, it is recognized that such contributions can have positive effects to the educational process. Students are enabled to make conscious

decisions about a sustainable future and also see the possible changes they could make in their own lives.

When experts are actively involved in such educational approaches, it is important to recognize the different types of knowledge they possess. Especially the differences between experts and novices (in this case: high school students) can be large (Edelson & Gordin, 1998). Experts possess a lot more tacit knowledge than students and such knowledge, because it is based upon experiences, is hard to share with others. Explicit knowledge, on the other hand, is easier to share (Davenport & Prusak, 2000 and Nonaka & Takeuchi, 1995).

Nonaka & Takeuchi (1995) describe the knowledge conversion process, which happens on the basis of social interaction between individuals and consist of the four different modes of socialization, externalization, combination and internalization. This is referred to as the SECI-process. In order to convert tacit into explicit knowledge, a 'field' will have to be created which allows face-to-face contact of individuals. This way, individuals can share mental models and body language, finally allowing tacit knowledge to be converted into explicit concepts (Nonaka & Takeuchi, 1995).

The literature review then shifted its focus towards the supportive role that ICT-tools can have with the integration of experts' knowledge into the educational process. ICT-tools are numerous and include e.g. Internet, e-mail and Windows Live Messenger (MSN). Such tools allow communication and cooperation of resources between persons (Bataineh & Tubaishat, 2009). Even though scholars acknowledge that some ICT-tools are becoming more and more suitable to support the expressions of portions of tacit knowledge, it remains unclear exactly how far these possibilities actually reach. Scholars do recognize that ICT-tools allowing the communication of body language, intuition and learning-by-doing have more added value in this respect (Griffith, Sawyer, & Neale, 2003 and Mohamed, 2007)

A method, which uses externalization to integrate experts' knowledge, has been described in literature (Backhaus et al., 2006). Several ICT-tools, such as videoconferencing, chat, e-mail and discussion forum, allow more direct communication links (Baars et al., 2006). The advantages that these tools have for the educational process and the contributions that experts can deliver through the support of these tools were consequently examined.

The most important parts and theories of the literature review finally led to the development of the following conceptual model, represented in Figure 3:

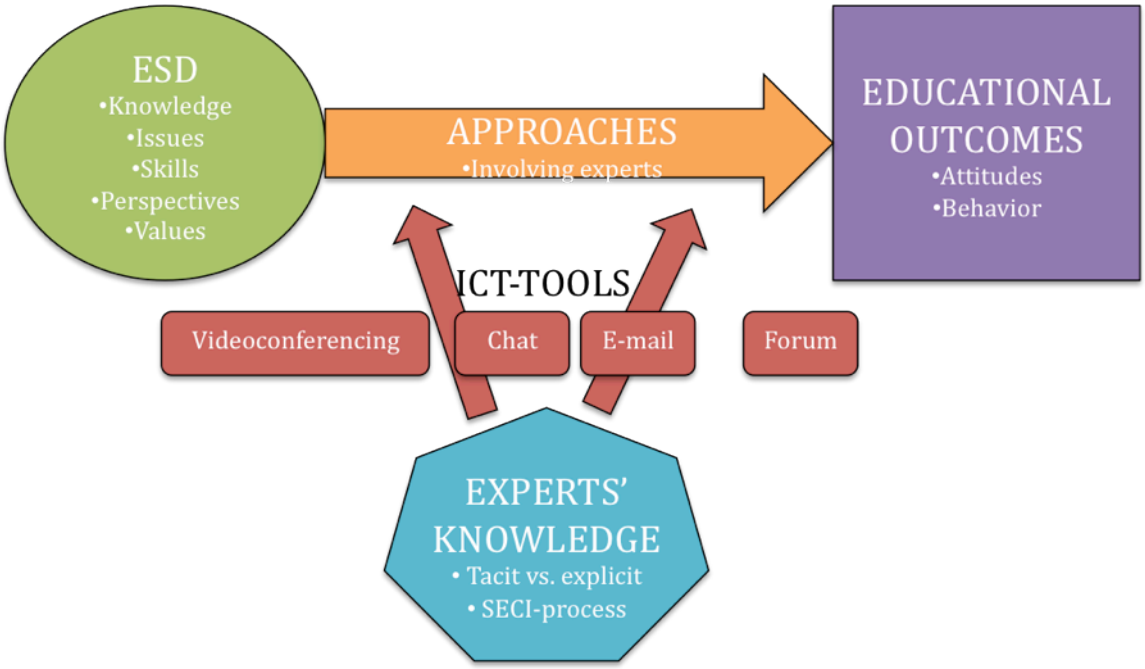

Figure 3: Conceptual model

A closer analysis of the model reveals the following:
ESD approaches should take into consideration knowledge, issues, skills, perspectives and values (indicated in the green ball). The expected outcomes of these approaches can be classified into two main categories, changes in attitudes and changes in behavior, where attitude change leads towards behavioral change (indicated in the purple square). In order to reach these changes, a whole range of ESD approaches have been developed. Several of these ESD approaches involve the contribution of experts (indicated in the orange arrow). ICT can help with the integration of experts' knowledge into the educational process. Hereby should be kept in mind that experts possess different kinds of knowledge and the way their knowledge is converted into more explicit concepts through the SECI-process (indicated in the blue heptagon). Indentified ICT-tools include videoconferencing, chat, e-mail and the use of a forum (indicated by the red arrows and cubicles).

The following three propositions were developed and tested on the basis of this model and used to structure the empirical research:
P1: The contribution of experts in the teaching process is useful and leads to desired educational outcomes.

P2: The identified ICT-tools (videoconferencing, chat, e-mail and forum) are used on a regular basis within the educational process.

P3: Experts can contribute to the educational process in a constructive and positive manner with the support of ICT-tools. However, some difficulties could be expected because of the differences between experts and students and the capacities of ICT-tools to deal with these differences.

5. Empirical findings

The foundations laid by the literature review, consisting of the three different propositions, enabled a closer look at different practical case studies. Empirical data was gathered through the examination of high schools and ESD programmes working with ICT. Their logos are depicted in Figure 4:

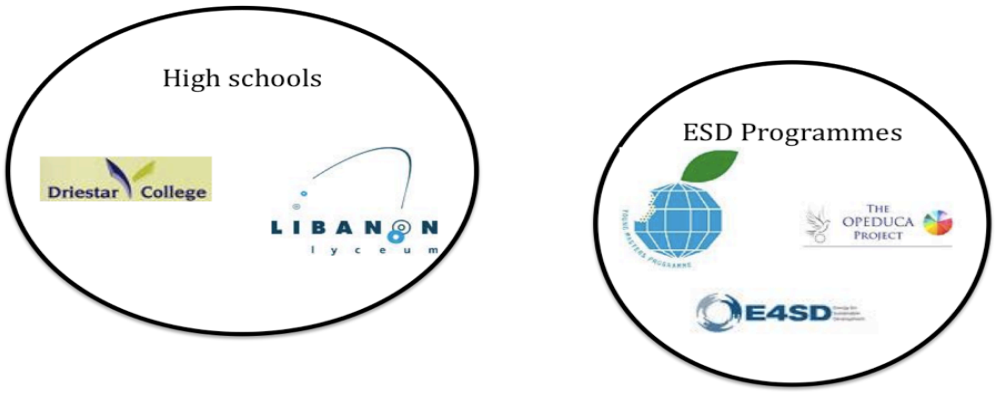

Figure 4: Different logos of visited high schools (Driestar College, Libanon Lyceum) and studied ESD Programmes (Young Masters Programme, Energy for Sustainable Development & OPEDUCA)

5.1 High schools

Two different high schools participating in the SvD project, the 'Driestar College' and the 'Libanon Lyceum', were visited and several persons were interviewed. The case studies show how the SvD project is integrated into high school curricula, by providing a general idea about the practical and other issues students and teachers have in respect to implementation and execution of the project. The examination of these cases also shows how experts are involved in the educational setting.

Two staff members at the schools, a teacher and a rector, thought that the contribution of experts was valuable for the educational process. Experts can contribute to the project because they all have their own field of expertise and can create enthusiasm amongst students (M. Van der Grond, personal communication, June 18, 2009 and P. Scharff, personal communication, June 25, 2009).

Furthermore several students, who are not specifically indicated here, were asked about the approach of the SvD project and their experiences when contacting experts with the help of ICT. Three students and their project groups had e-mailed an expert and received a reply. One student's group had sent out an e-mail but did not receive a response and another student's group had not used the possibility to contact an expert at all. One student's group had used email to contact the expert and arrange a face-to-face meeting. When the different students' groups did get a reply, this reply was seen as valuable to their project work and could be used. Only once was the provided information partially too complicated to use for the students (Several students, personal communication, diverse dates, 2010).

One IVN-volunteer, who had participated in the role of an expert in the SvD project, was interviewed for the purpose of this research. He feels that his contributions as an expert could be important to be able to make students question their living surroundings, the way things are arranged and how things can be improved. He also indicated that it is difficult, as an expert, to share experiences that come forth from for example his work. A student would not learn these experiences from his/her high school period. The role of the expert, when contacting students, could therefore be more one of an 'eyes opener'. It is thereby of importance that a student shows willingness to openness and affinity. E-mail was mentioned as the ICT-tool, which would allow time saving and flexible use when participating in the project (A. Hilgersom, personal communication, September 4, 2009).

5.2 ESD Programmes

Empirical data gathering was also done amongst several ESD programmes that use ICT and integrate or are planning to integrate experts' knowledge into their curricula.

The International Institute for Industrial Environmental Economics (IIIEE) in Sweden offers two of the selected programmes, the Young Masters Programme (YMP) and the Energy for Sustainable Development (E4SD) course.

The Young Masters Programme (YMP) has been running since 1999 and is a good example of the youth being involved in sustainability issues through distance education. The YMP engages 16 to 18 year old students from throughout the world in each year's Programme. The Programme's contents are presented online. The Programme also offers the possibility to provide feedback to other students and teachers in forum discussions.

The Programme's Director acknowledges that solving sustainability issues is not a linear process and therefore cannot be approached this way. YMP students, when cooperating on working towards solutions for complex issues can, in the future, have a whole range of ICT-ranged possibilities to support their efforts. Such possibilities include, amongst others, knowledge bases, methods, interviews with researchers, background documents and communities of feedback of teachers and students as key resources (T. Jacobsson, personal communication, May 6, 2009).

The Energy for Sustainable Development (E4SD) online course focuses upon sustainable energy choices. The course is taught through Internet and uses a web platform, forum and email and creates a platform for course participants to exchange their knowledge and experiences within the energy and development field (K. Paulavets, personal communication, May 11, 2009). Experts provide additional input to the course by stimulating the discussions in the forum and providing feedback on assignments. Experts are selected on their 'energy' skills (L. Strupeit, personal communication, May 11, 2009). The approach of the course shows that it is important to have certain preconditions in place when organizing the involvement of experts through the use of ICT.

Finally, the Regional Centre of Expertise (RCE) Rhine-Meuse, located in the Netherlands (Limburg), offers the OPEDUCA project. This project looks into ways of providing youngsters with better development opportunities when different aspects at a regional level are cooperating together. The project focuses upon different themes covering the environment and ecology and supports the vision of learning taking place 'anytime, anywhere, with anyone and anyhow' (J. Eussen, personal communication, July 28, 2009).

OPEDUCA uses an open source web to which web pages can be added. The website will eventually allow users to upload and download text, pictures, movies and create blogs. Young people know very well what the possibilities of ICT are and it is therefore up to the organizations to innovate in this respect. In the educational process, it is the student who chooses which ICT-tool he/she wants to use to contact the expert. An expert will then only need to possess the right electronic equipment in order to cooperate. The advantages of such an approach is that it creates easy access, cooperative learning and possibilities for everyone to join in (J. Eussen, personal communication, August 4, 2009).

6. Discussion

The conceptual model, which was based on the performed literature analysis, led to the creation of three propositions that were introduced in section 4 of this paper. This section will give a short overview of the outcomes to these propositions.

Firstly, proposition nr. 1 looked into the question whether contributions of experts are considered to be valuable for the educational process. Interviews with different sources, represented by different persons professionally involved with secondary education, point towards the relevance and importance of experts in the teaching process. Students also supported this consideration. Furthermore, examined ESD programmes show evidence of the added value that experts can have for the teaching process.

Proposition nr. 2 then examined which ICT-tools are used on a regular basis within the educational process. All students' groups who had contacted experts used the communication tool of e-mail to communicate their ideas and thoughts with these experts. Moreover, the interviewed IVN-expert indicated that e-mail would be the ICT-tool that he would use when cooperating in the SvD project. Existing ESD programmes showed the use of a forum which allowed interaction between experts and students but students are also encouraged to use the whole range of thinkable ICT-tools that could support the educational process.

Proposition nr. 3, finally, analyzed what kind of difficulties could arise through the use of ICT-tools. The students who had received feedback from experts indicated that this was relevant. However, in one case the provided information was partially regarded to be too difficult. This could form an example of the different knowledge bases between high school students and experts and how the complexity of the project in which students get involved, also evokes feedback from experts which includes more complex knowledge. In order to prevent such difficulties from arising, several safeguards have been identified which are already in place within the examined ESD programmes to optimally integrate ICT-tools within the teaching process.

7. Conclusion

7.1 Answers to the research question

The research question, which formed the basis for the in this paper discussed research, is repeated here:

"How can ICT approaches support the integration of experts' knowledge into high-school sustainability (-ESD-) projects of NGOs?"

Both the literature review as empirical data collection revealed the importance of experts taking part in the teaching process. However, as ICT-tools become increasingly efficient, effective, less expensive and younger generations are more knowledgeable about their use, such tools should be increasingly used in education. Ways of integrating experts' knowledge into the classroom through the help of ICT-tools therefore need to be examined.

The different ESD programmes that were examined use several approaches in order to integrate ICT into the teaching process. When students contact participating experts in the programmes, it is often through ICT-tools that do not allow any audio/visual contact between the parties communicating with each other. Even though rich media tools are increasingly enabling tacit knowledge transfer between persons who are communicating through the use of ICT, the question remains how much of such knowledge can be really understood and grasped by high school students in for example an audio-video Skype meeting of half an hour. Furthermore, practical dilemmas, like time issues, would make it difficult for an expert to cooperate with such a meeting in the first place.

The differences between students and experts, the characteristics of tacit knowledge and the goals of an ESD approach such as the SvD project make it questionable whether it is always the aim of such approaches to integrate the whole knowledge basis of experts into the educational process. The role of an expert, who is contacted by students solely through the use of ICT-tools, in a project such as SvD can also be one of an 'eye opener' for students, teaching them that they should ask questions about their living surroundings, the way things are arranged and how things can be improved in order to work towards sustainability. The willingness of students to show openness and their affinity with the issues they are working on, are also important aspects that would accelerate this process. This does not mean that the original roles that the SvD project ascribed to experts should be forgotten or neglected.

7.2 Recommendations

The main findings led to the following recommendations that can be of use for NGOs that want to be involved in offering ESD through the help of ICT and hereby include the knowledge of experts:

- Creation of a specific website for the project.
- Experts and teachers should be informed about the range of ICT-tools that are available and the (dis)advantages of these tools.
- Experts should be made aware of the existing difficulties that ICT-tools possess when it comes to sharing experiences with students.
- NGOs can play an important role in combining ESD and ICT when it comes to creating a 'window to the world' for students.

References

Baars, G. J. A., Wieland, A., Van de Ven, M. J. J. M., & Jager, K. M. (2006). Leren (en) doceren met digitale leermiddelen in het hoger onderwijs. Den Haag: Lemma.

Backhaus, W., Sattari, S., Hees, F., & Henning, K. (2006). A web-based knowledge map for integrating expert knowledge into higher education. Proceedings from ITHET '06: The Seventh International Conference on Information Technology Based Higher Education & Training (July 10-13).

Bataineh, E., & Tubaishat, A. (2009). The role of laptop as a platform in an outcome-based learning environment. Proceedings from eL&mL '09: The International Conference on Mobile, Hybrid and On-line Learning.

Davenport, T. H., & Prusak, L. (2000). Working knowledge: How organizations manage what they know. Boston: Harvard Business School Press.

Domask, J. J. (2007). Achieving goals in higher education. An experiential approach to sustainability studies. International Journal of Sustainability in higher Education, 8.

Edelson, D.C., & Gordin, D. (1998). Visualization for learners: A framework for adapting scientists' tools. Computers & Geosciences, 24.

Flint, R.W., McCarter, W., and Bonniwell, T. (2000). Interdisciplinary education in sustainability: Links in secondary and higher education. International Journal of Sustainability in Higher Education, 1.

Griffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and knowledge in teams: Managing the love triangle of organizations, individuals, and information technology. MIS Quarterly, 27.

Huisingh, D. (2007). Emerging academic responsibilities and opportunities for promoting regional sustainability & fulfilling the Millennium Development Goals. Environmental Engineering and Management Journal, 6.

IVN (2009). IVN Natuur- en milieueducatie. In IVN Nederland. Retrieved from: http://www.ivn.nl

Mohamed, M. S. (2007). The triad of paradigms in globalization, ICT, and knowledge management interplay. VINE, 37.

Nonaka, I., & Takeuchi, H. (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. New York: Oxford University Press.

Training Guideline on incorporating Education for Sustainable Development (ESD) into the curriculum (n.d.). Retrieved from http://www.ibe.unesco.org

United Nations Educational, Scientific and Cultural Organization (2005). Guidelines and recommendations for reorientating teacher education to address sustainability. Paris: UNESCO.

Van der Waal, M. E., & Wals, A. E. J. (2009). Bouwen aan succes: Drie voorbeelden van toparrangementen in het onderwijs, gezien vanuit het perspectief van aanbieders, bestuurlijke actoren en eindgebruikers. Wageningen: Wageningen UR.