מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

מכון דוידסון לחינוך מדעי
DAVIDSON INSTITUTE OF SCIENCE EDUCATION

ICOLE
International Conference of the
Outdoor Learning Environment

The 1st International Conference of the

OUTDOOR LEARNING ENVIRONMENT

February 3-8, 2013
Weizmann Institute of Science, Israel

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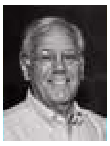
Organizing Committee

Prof. Nir Orion
Weizmann Institute of Science, Israel



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מפעלי ים המלח בע"מ

פארק תמנע
Timna Park

ISRAEL NATURE AND PARKS AUTHORITY

Introduction

One of the main obstacles of education in schools is that many students fail to see the relevance of school learning to their daily lives. Curriculum developers and teachers try to overcome this problem by integrating relevant stories and images in books and by using the computer learning environment. Meanwhile, few use the real world – the outdoor learning environment – as an integral component of the learning process. Moreover, many of the outdoor visits that do occur are informal events and not an integral part of formal school curricula. This situation reflects the relatively limited research of the outdoor learning environment as an integral part of the formal learning.

The main purpose of this conference is to establish an international community of researchers who study efficient ways to implement outdoor learning activities as an integral part of the formal school curricula. Throughout the conference, we will communicate and exchange ideas, present our current knowledge, and discuss the future research agenda for those in our community.

The conference focuses on studies that were conducted in relation to the integration of outdoor activities into a formal K-12 curriculum in any discipline. Our unique 5-day "wandering conference" will allow us to interact with a variety of outdoor environments such as: the schoolyard, open natural areas, national parks, museums, zoos, urban environments, industrial sites, and archeological sites.

Through concrete interaction with the above learning environments, we will discuss topics such as:

- Strengths and weaknesses of the various learning environments.
- Ways for integrating the outdoor environment as an integral component of the formal curriculum.
- Learning materials and methods that might take advantage of the strengths of a specific outdoor learning environment and avoid its limitations.
- Unique cognitive aspects of the outdoor learning environment.
- Unique affective aspects of the outdoor learning environment.
- Professional development (or change) programs for helping teachers to use the outdoor learning environment.
- Conducting research in the outdoor learning environment.

Our journey will begin and end in Rehovot at the Weizmann Institute of Science, and will pass through Mitzpe Ramon, Eilat, the Dead Sea, and Jerusalem. Each day will include interactive sessions and an educational visit to an outdoor learning environment where the methods of conducting field trips in outdoor learning settings will be modeled. We will visit schools that use their outdoors as a learning environment while we visit some of the most spectacular landscapes in the world.

Finally, we decided to change the title of the conference from ICOLE to the 1st ICOLE and we really hope that this conference will be a first major step in placing the outdoor learning environment in a more central position within the school setting. There are millions of kids all over the world who do not find their way in schools and are waiting for us to make their school experiences more relevant to their daily lives.

We wish you all a fruitful and pleasant conference!

Nir Orion, Chair of the Organizing Committee

Sunday, February 3, 2013

09:15	Registration
10:00	**Opening ceremony** – Clore Garden of Sciense
11:00	*Coffee break*
11:30	Welcome address **Prof. Nir Orion,** chair of the organizing committee
11:50	Plenary session **Dr. Gil Gertel:** The roots of outdoor and experimental learning in educational philosophy
12:30	*Lunch break*
13:30	**Outdoor demonstration** - The Open Science Museum
15:00	*Coffee break*
15:15	**Interactive session**
17:00	**Outdoor demonstration:** Chaim Weizmann house – History
18:00	Summary session
19:00	*Dinner*

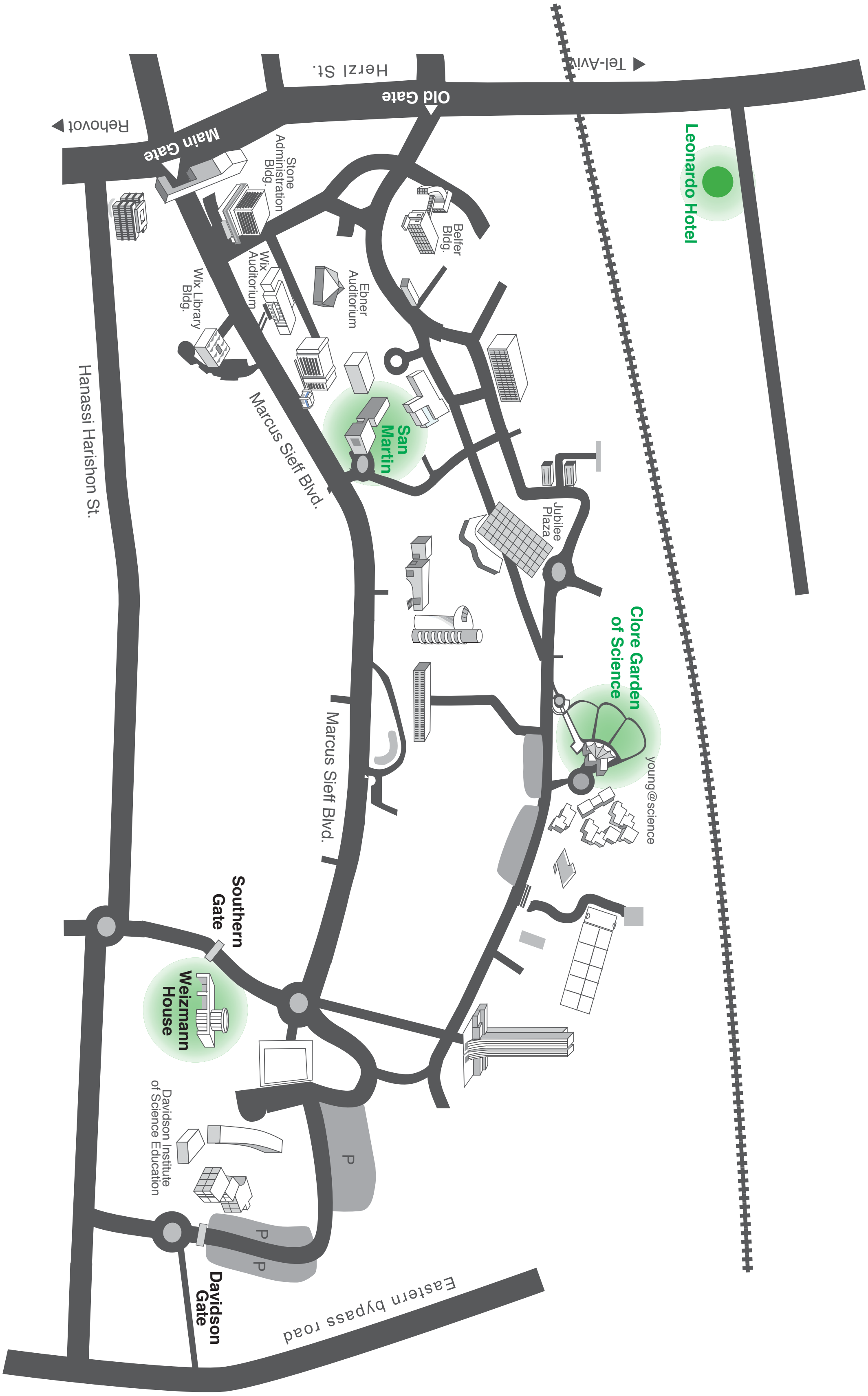
Monday – February 4, 2013

07:00	*Breakfast*
08:30	Traveling towards **Mizpe – Ramo**n area
10:30	**Outdoor demonstration:** Machtesh Hatira geological site
11:45	**Sde-Boke**r Environmental high school
12:15	*Lunch break*
14:00	Arriving at **Mitzpe Ramon Inn** and getting settled
14:15	*Coffee break*
14:30	**Interactive session**
16:30	Free time for walking along the Machtesh promenade.
19:00	*Dinner*
20:00	**Plenary session** **Dr. Molly Yunker:** Ideal to Real: the Transition from Perfect Settings to Imperfect Environments

Tuesday – February 5, 2013

07:00	*Breakfast*
08:00	Traveling to **Eilat** (Red Sea)
08:30	Short walk in the Machtesh (Carpentaria)
11:00	**Yotveta** (Malla Shahrut) school
11:45	Outdoor demonstration: **A zoo learning environment (Hai-bar)**
12:30	*Lunch break*
13:15	Outdoor demonstration: **Timna Park**
14:30	Arriving at the hotel (King Salomon) and getting settled
14:45	*Coffee break*
15:00	**Interactive session – Hotel**
16:30	Free time for visiting the Red Sea beaches.
19:00	*Dinner*
20:00	**Plenary session** **Prof. Tali Tal:** Museums and nature: common issues in different learning environments

Weizmann Institute of Science Map



Sunday, February 3, 2013

09:15	Registration
10:00	**Opening ceremony** – Clore Garden of Science » **Prof. Israel Bar-yossef,** Vice president, Weizmann Institute of Science » **Prof. Bat-sheva Eylon,** Head of the Science Teaching Department, Weizmann Institute of Science » **Dr. Ariel Heimann,** Director of Davidson Institute » **Mr. Roni Naaman,** Ministry of Education
11:00	*Coffee break*
11:30	Welcome address – The Open Science Museum **Prof. Nir Orion,** chair of the organizing committee
11:50	Plenary session **Dr. Gil Gertel:** The roots of outdoor and experimental learning in educational philosophy
12:30	*Lunch break*
13:30	**Outdoor demonstration -** The Open Science Museum, Weizmann Inst.
15:00	*Coffee break*
15:15	**Interactive session –** The Open Science Museum » **D. Tsybulskiy, J. Dodick and J. Camhi:** Design and Implementation of Field Trips to University Research Labs » **N. Lavi-Alon, T. Tal and O. Morag:** Pedagogical Content Knowledge in Outdoor Education » **J. Forrester, E. Flaherty, M. Ben-David and S. Walker:** The Impact of Field Research on Students Conceptual Understanding of Climate Change » **J. McLaughlin, K. Fadigan and D. Munsell:** Open Inquiry-Based Science Learning in an International Field-Course: Students as Research Scientists and Global Citizens » **B. Reiser:** Design strategies for supporting scientific explanation and argumentation about ecosystems
17:00	**Outdoor demonstration:** Chaim Weizmann house **–** History
18:00	Summary session
19:00	*Dinner*

The roots of outdoor and experimental learning in educational philosophy

Gil Gertel

Didactic Team LTD, Israel

It is customary to think that the use of outdoor and experimental learning is something original from our progressive era. But, in fact, the roots of this approach are profound deeply in educational philosophy and in the distant past.

The roots of the progressive education are to be found in the 16th century, with the development in human perception about his value. Man had set himself the right to look at the world, ask questions about its nature and essence, and look for answers, not only in a direct and intuitive way, but with high thinking skills like abstraction and generalization. In 1615 the philosopher Francis Bacon defined the course of scientific thinking, as such consisting of collecting evidence from the real world and inclusion them towards an abstract explanation.

The first to implement these changes into the field of education was John Amos Comenius, Czech educator and bishop. He convened his ideas in 1632 in the book "Magna Didactica", which is a program to establish public school. Comenius desired to spare the children the boredom and lack of purpose that characterized schools, and replace the education of obedience with an education for self-development.

For this he adopted Bacon's scientific method into schools. Including:

1. The real world replaces the books as the source of knowledge and the topics taught at school;
2. Learning from sensory experience replaces the memorizing as the teaching method;
3. Personal experience of each student for himself replaces the practice of transferring "material" from a teacher to a group of students.

Although 400 years have passed since these ideas emerged, we haven't found, yet, the way to implement them in public school system.

The Open Museum Worksheet

Take 15 minutes for exploring the museum (use the attached map) and pay attention to the following aspects: learning, teaching (guiding), apparatus, other aspects.

A. Learning and teaching

- If you meet a group of students please write down your impression of their learning behavior:

1. What kind of interaction the students conduct with the apparatus?

2. What percentage of students are actively interacting with the apparatus?

3. What is the role of the museum guide?

4. What is the role of the teacher of the group?

5. How were students prepared for the visit

6. Try to ask students what they have learned here and how it relates to their school learning.

B. Apparatus

- Choose an apparatus and try to suggest how to use it as a learning tool

1. Select the curriculum and the age level with whom you would use this apparatus (see table next page).
2. Write in the table (next page) the concepts / skills that you would develop for the activity.
3. Describe the direct interaction with the apparatus that will lead to the construction of the concepts/skills?

4. How would you prepare the students for this visit? ....

....

5. How would you continue the activity in the classroom? ....

....

Subject matter	**Elementary school**	**Middle school**	**High school**
Science for All	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Chemistry	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Earth science	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Physics	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Art	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Mathematics	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Languages	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Physical Education	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Environment	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Literature	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
History	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Geography	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....
Other:	Concept/skill:.........................	Concept/skill:.........................	Concept/skill:......................... ....

C. Strengths and Weaknesses

1. Consider the open museum as a learning environment that is an integral part of the school curriculum. What are its strengths? ....

2. Consider the open museum as a learning environment that is an integral part of the school curriculum. What are its weaknesses? ....

Design and Implementation of Field Trips to University Research Labs

Dina Tsybulskiy, Jeff Dodick and Jeff Camhi

The Hebrew University of Jerusalem, Israel

Universities conducting excellent scientific research dot the map of many nations around the world. Surrounding them are high schools where students learn the final results of such research, but few of these students ever get to see how that research was conducted. In order to introduce students to the frontiers of modern scientific research and research methods in the life sciences we designed, implemented and evaluated a novel "science as inquiry" learning unit focused on field trips to university research labs. The study involved Grade 11 biology students from the Jerusalem area (n=293), their teachers (n=14) and guides, who were graduate students from Hebrew University's Life Science Institute (n=6). We employed multiple qualitative sources of data. In this paper we present some challenges and benefits of the units' implementation from the perspective of the guides and teachers. It was found that many variables factors affect the unit's implementation, including administrative, human and physical components. At the same time, this experience brought a number of important significant benefits to the students, teachers and guides.

Subject:

In this study we designed, implemented, and evaluated a novel learning unit focused on field trips to university research labs. In those trips, Grade 11 biology students visited university labs, interacted with scientists (both professors and graduate students), were introduced to frontiers of modern scientific research in the life sciences and their research methods, and were exposed to an authentic laboratory atmosphere.

Most interventions bringing students into university research labs are mentoring programs in which students conduct hands-on, ***science by inquiry*** research. However, only a small number of students can participate in such programs. For example, in Israel only 200 biology students nation-wide participate in high school lab-mentoring programs. Mentoring programs, then, are often designed for an elite student population; thus most students miss out on such authentic inquiry experiences.

Our unit can engage reasonably large numbers of students and is structurally close to the Schwabian (1966) ***science as inquiry*** model, in that it focuses on representing the Nature of Science (NOS) to students by developing student-researcher dialogue during lab visits, as well as by analyzing historical narratives in school.

In this paper we discuss some challenges of the unit's implementation and some of its benefits from the perspective of the teachers and guides.

Study Design:

Implementation of the unit follows the tripartite model of Orion (1993) for teaching field and museum trips:

1. In-class preparation: This includes Power Point presentations about the two labs that the class will visit; written material about methodology in cell biology and ecology; and student preparation of specific questions to be asked during the lab visits.

2. Lab visits: Two labs are visited: cell biology and ecology, based on two of the subjects the students are studying in their high school biology program. The students spend two hours in each lab. The visits include interactions with the equipment, but the focus is on creating a dialogue between the students and their scientist guides about how the latter group conducts their research.

3. In-class summary: This is based on the students' analysis of historical narratives, as well as their writing reflective journal pieces summarizing their experiences during lab visits.

The in-class preparation and summary are mediated by the teachers using materials we created in consultation with them. The lab visits are guided by graduate research students in their home labs. Overall, this unit requires 3-5 weeks to complete. We worked with three different labs in the field of cell biology and three in ecology, with each student group visiting one lab in each of these fields. We selected labs based on the relevance of their specific research subjects to the Israeli high school biology curriculum and the availability of graduate students we judged would be skilled at interacting with non-specialists. To enhance the effectiveness of the unit we trained both the graduate students and the participating teachers.

The study involved 293 Grade 11 biology students from the Jerusalem area (14 groups from 8 schools). The research sample consists of 14 teachers and 6 graduate students from Hebrew University's Life Science Institute serving as guides.

We collected data from 2009-2012 by using qualitative instruments (semi-structured interviews, videotaped observations and textual content analysis of teacher journals). The data were analyzed using Shkedi's (2004) constructivistic (ethnographic) method of qualitative research.

Results and Discussion:

Field trips to university research labs connect formal (school) and informal (university labs) learning environments. We found that many variables can affect and challenge its implementation (Figure 1).

Regarding the **human components,** we found that all 14 teachers who volunteered to participate in the project had at least an M.Sc. in biology/science education and extensive experience in teaching (more than 10 years). Thus, they could relate more comfortably to research, which allowed them to personalize the unit, based on their experiences. Six guides participated: five of them are Ph.D. students whereas one is an M. Sc. student; three of the guides had previous guiding experience while three did not. All of them volunteered to participate in the project.

Administrative and logistical components such as set a date/time for visit or travel and costs were critical factors affecting teachers' and guides' readiness to participate in the unit's implementation. This problem made it difficult for us to attract students from regions outside of Jerusalem to our unit at the Hebrew University. Moreover, these factors were indicated by teachers and guides as the main challenge in the unit's implementation, especially because of different scheduling and priorities of schools and labs.

Physical components were significant factors that became a challenge for field trips to labs because labs are not designed to host student groups. They are quite small; some of them (especially ecology labs) are so disorderly that they sometimes "turned" students off, especially in comparison to the very modern and orderly cell labs. Although we made sure not to put a large number of students in a single lab, teachers and guides still indicated that these factors created a challenge for this project.

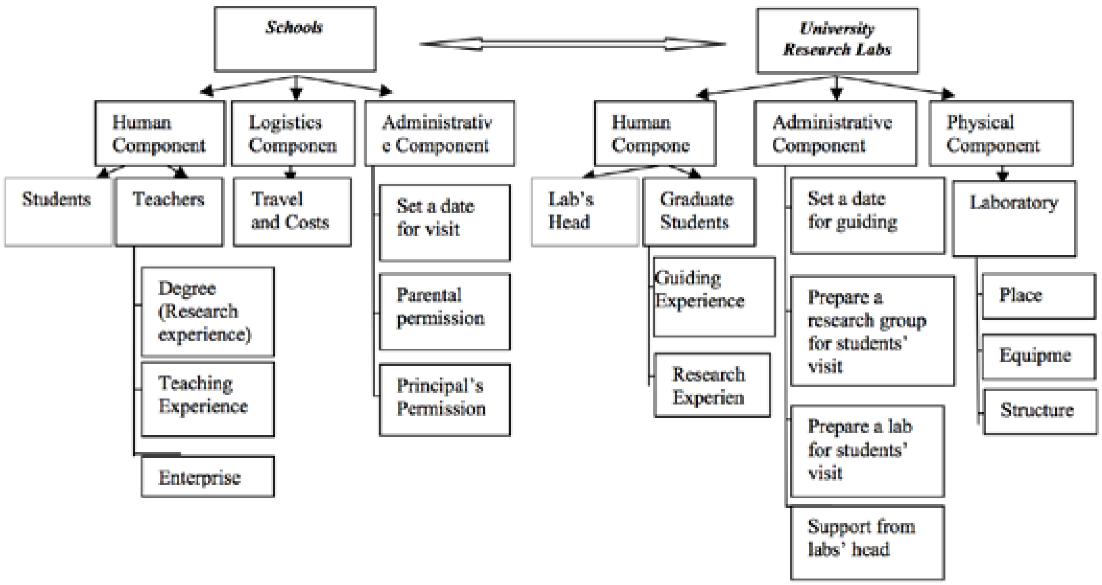


Figure 1: Factors that could challenge field trips to labs

Despite the challenges, teachers and guides still saw many important benefits of these field trips (Figure 2). Both teachers and students valued the positive effect of the field trips on the students on both the cognitive and affective levels. Teachers indicated that *"the unit is the best way to teach and present to students elements of scientific inquiry and NOS"* [teacher's diary, 2011].

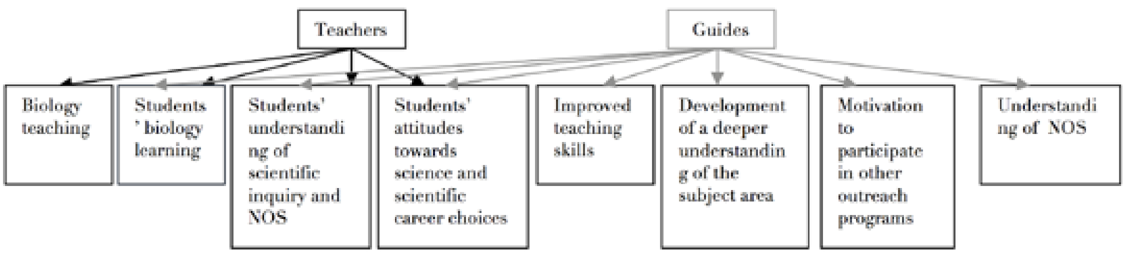


Figure 2: Benefits of Field trips to labs

The guides valued the opportunity to improve their teaching skills, including the ability to explain complex subjects outside of an academic audience, such. They indicated that by having to explain the fundamentals of their field to high school students they developed a deeper understanding of their own subject area. Moreover, they came to understand that some NOS aspects that they learned from this project helped them to develop a meta-view on biology research in general and their own research in particular. In addition, the positive experience of participating in this project affected their motivation to participate in other outreach programs. All six guides have continued to participate in other outreach programs. One of them, who had no previous guiding experience said: *"This experience was very significant for me. I think the university should require participation in such projects."* [Ph.D. student, interview, 2012].

Conclusion

Implementing this lab visit unit was a complex experience, which involved a large set of factors and general organization; nevertheless, there are a large number of potential benefits for students, teachers as well as graduate student guides.

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Pedagogical content knowledge in outdoor education

Nirit Lavi-Alon, Tali Tal and Orly Morag

Technion, Israel

Field trips are complex and expensive events. They are perceived as good educational experiences, but rarely do teachers and administrators question their effectiveness in terms of learning and developing attitudes toward the environment. Unlike school based learning, field trips are not evaluated and quite often they are viewed as missed opportunities due to unclear expectations or because of gaps between what is viewed as good school teaching and the common practice in the field. In this study of outdoor-education in nature, we aimed at investigating nature guides' practice in general and their pedagogical-content-knowledge (PCK) in particular, and scrutinizing student self-reported outcomes with respect to guides' practices. We followed-up 34 field-trips provided to grades 4-8 by various carriers through observations and interviews with students, teachers and guides. We found a range of practices in few domains: active learning, physical experiences, environmental action etc. We suggest that the use of the idea of PCK could add a valuable lens to look at outdoor-education as well as inform our understanding of field trips and preparation of professional guides. As many field trips are planned to support school based teaching, improving teaching practices in field trips can positively affect school-based learning as well.

Unlike extended teacher preparation programs, professional guides, who facilitate most of the school field trips to nature in Israel, enroll in a rather short course of few months that is dedicated mainly to teaching subject matter knowledge and to learning specific trails as well as to teaching about pedagogy. Naturally, deeper teaching about learning theories is not part of such preparation processes. In addition, issues such as safety and security, and teachers' concerns about unexpected disasters lead many nature guides to employ a conservative approach to explanations. As such they make considerable efforts to tell as much as they can about the field trip area. In this study we borrow two concepts from formal education and use them in the context of school field trips to nature. The first concept is ***teaching*** – in Hebrew, we use the term guiding to describe the practice of informal educators; however, following Hofstein & Rosenfeld (1996) we refrain from dichotomizing learning in school and out-of-school. We view the practice of the persons who plan and facilitate the learning activity as teaching regardless of where the activity takes place. The second term is pedagogical content knowledge (PCK), which we study in the context of the natural (learning) environment.

Goal. We aimed at investigating nature guides' practice in general and their PCK in particular, and examining student self-reported outcomes with respect to the guides' practices.

Theoretical framework. Two main fields informed our framework: the field of outdoor education, and the field of teachers' PCK.

Most of the literature on out-of-school learning comes from museums because investigating school visit to museums is less complicated than studying field trips to the outdoors. However, a review of outdoor education from the UK and elsewhere served as the basis of our study (Rickinson et al., 2004). There are other studies as well, including our own that point to the importance of pedagogy in field trips (i.e., Brody, 2005; Orion & Hofstein, 1994; Authors, 2012). Field trips to nature are appreciated as a positive comprehensive experience, but the literature points to challenges and missed opportunities resulting from insufficient planning, traditional teaching in the form of "delivering messages", and teachers' reluctance to take their students out of school. Maynard and Waters (2007) who referred to field trips to nature as "missed opportunity"found that even in early elementary school grades in Wales, teachers were focused mainly on content and neglected social activity in the outdoors. They were task oriented and focused on teaching content and skills instead of employing a more student-centered approach and allowing more freedom and social experiences. In an Australian study, most students indicated they were looking forward to their field trip. However, primary and secondary school students differed in what they liked or disliked in the field trip. Disliking learning activities was similar in both groups (Ballantyne & Packer, 2002). Brody (2005) highlighted the importance of social interactions and of student activity. Our own study of field trips to nature indicates insufficient attention to pedagogy in general and to the unique affordances of activity in a natural environment in particular (Authors, 2012). This led us to examine the idea of PCK in outdoor education. PCK is the unique knowledge that is relevant to how to teach content, how to determine if students understand, how to identify their difficulties, how to help them overcome these difficulties, and how to make them like what one teaches (Shulman, 1986). Magnusson, Krajcik & Borko (2001) stressed that planning and teaching any subject is a highly complex activity in which the teacher must apply knowledge from multiple domains, and that teachers with integrated knowledge will have greater ability that those whose knowledge is limited and fragmented. With this respect, in outdoor education there are even more domains of knowledge. Content knowledge is multidisciplinary, and PCK has unique characteristics that are not yet identified or studied.

The study

We studied about 30 field trips provided to students in grades 4-8 (age 10-14). Most of the half day or whole day field trips were to nature reserves and to archeological sites. We observed each field trip and interviewed the guide, the schoolteacher and 3-4 students per class. We focused on: connection to the school curriculum and communication with the schoolteacher, active learning, empowering physical experiences, using the environment and what the students see and find, discussing environmental issues and enhancing pro-environmental behavior. The main categories used in the data analysis were: (a) using the environment – the way the guide uses objects, artifacts and the general features in his/her teaching; (b) active learning – the extent to which the guide involves the students in exploring, discussing, explaining and doing things individually or in small groups; (c) reflection and affect – the extent to which the guide makes the students reflect upon the experience and describe and discuss feelings; and (d) environmentalism – the extent to which the field trips to nature allows the guide to discuss nature conservation and other environmental values with the students.

Findings

The vast majority of the guides were pleasant, and treated the students with respect. Connection to the school curriculum varied and was dependant on the school teacher as well. In cases the teachers took a more active part and referred to what they taught in class, such connections were more explicit. In several field trips we did not observe any attempt to connect to anything studied at school, and in others, many connections were discussed. Most of the guides used demonstrations, drawings and models to explain phenomena. Genuine active learning was found in about half of the field trips. In such field trips, the guides facilitated educational games, during which students were exploring their surroundings. One example was an activity held in an ancient cave site, in which students discovered "ancient" scripts written on pieces of clay and had to decode them to come up with the story of the place. Physical activity beyond merely walking the trail was found to be a significant experience for the students. Only a few guides attempted to enhance and empower simple experiences. The guide of the field trip to the ancient graveyard, for example, made the students enter a dark cave, in pairs, holding only torches to discover the scripts. Another guide made the students cross a canal on the beach using ladders. Already before doing so, the instructions he gave were exciting and developed the students' expectations to challenge their difficulties. After the field trip, the interviewed students were all thrilled about this event, while the teacher found it unnecessary and even dangerous. Inquiry activities were not common. Although guides ask many questions that help the students listen, they do not develop their own questions or the students' questions to further exploration. In cases where guides used worksheets students expressed their reservations. Environmental action was observed only in few field trips, during which the students cleaned a dirty beach, or worked in a forest site clearing dead branches to prevent fire. Being in the place where 40 human beings were killed in that disaster and working to rehabilitate it gave the students deep feeling of self esteem. It is quite obvious that in a field trip to nature, the guides use the environment as a resource. In their interviews, they all emphasized that they expect the students to better know their environment and understand things they see outside. However, the extent to which they used the environment thoughtfully and purposefully during the field trip was not clear. We found much generic or routine practice with this respect. For example, a huge tree on the trail will always make the guide stop and tell its story, sometimes with the addition of a folkloristic tale. All the guides would explain about the area in an observation point on a mountain peak from which the whole area is observed. We were more interested in how little and modest findings of the guide or of the students are being used. A student found a tiny fossil, or a quartz crystal. Another, points to a bird nest on a tree, or the guide finds wild boar's droppings. The extent to which such findings are amplified by the guides varied considerably. While some guides made a big deal from every little thing the students found and looked enthusiastic about their findings, others did not show special excitement and did not elaborate on these objects.

Unlike the researchers who were quite critical in their interpretations, most of the interviewed students and teachers were satisfied with the teaching during the field trip. However, in only one third they acknowledged "good guiding" while in the other they expressed several reservations, though not direct criticism. In general, they described it as fair/okay.

With respect to outcomes reported by the students, 63% acknowledged the influence of the field trip on their attitudes toward nature and the environment; 16% indicated the field trip had no new effect since their attitudes were positive prior to the field trip. 57% indicated specific change in their behavior and pointed to good things they experienced in nature or bad things such as trash which made them change their behavior. Some pointed to specific things the guide or their teacher said or did during the field trip. We found more pro-environmental statements in field trips in which the guide or the teacher explicitly dealt with how to behave in the outdoors.

Summary

Field trips are complex and expensive events. They are perceived as good educational experiences, but rarely do teachers and administrators question their effectiveness in terms of learning and developing attitudes toward the environment. Unlike school based teaching that is extensively studied and to which sets of standards were developed, usually we have little demands from outdoor education. It is enough that the students enjoy, come back safely and that the school daily routine was changed to allow more fun. The questions about the quality of the educational experience and quality of teaching are not commonly addressed. We highlight some important aspects of PCK in outdoor education that can lead to better guide-preparation that includes and emphasizes the pedagogical aspect. As many field trips are planned to support school based teaching and elaborate or demonstrate natural phenomena, improving teaching practices in field trips can positively affect school based learning in some domains as well.

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The Impact of Field Research on Students Conceptual Understanding of Climate Change

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Sunday

This study was designed to document college students' conceptual understanding of climate change after participation in field research. The field research opportunity exposed student participants to the concept of global climate change and its potential effects on wildlife, specifically the ecological disturbance of broad-scale tree mortality related to the mountain pine bark beetle (***Dendroctonus ponderosae***). The least chipmunk (***Tamias minimus***) was used as a model species because it is ubiquitous to the landscape but has a strong affiliation to pine forests. Thirty-six undergraduates participated in this study taking a pre/post 7-point Likert scale survey to document perceptions and understanding of climate change. An outdoor field research experience was used as a treatment in an attempt to encourage positive conceptual change in students' understanding of climate change. Results indicate that students feel climate change is an important issue to discuss and one to develop a deep understanding of. Students also reported agreeing that: (a) climate change is a significant conservation challenge; (b) climate change will have a negative impact on wildlife; and (c) increases in temperatures from climate change is the primary cause of bark beetle population increases in Southeastern Wyoming. Implications of outdoor field experience are discussed.

Problem:

Human activity continues to impact and change earth's climate. Such change can be demonstrated by the altering composition of our atmosphere, effecting global temperatures (IPCC, 2007). These effects are expected to continue over the next twenty years. As such, climate change is a critical issue that we as a society need to be able to discuss through logical discourse. In preparing democratic citizens, capable of participating in decisions concerning the welfare of the local, regional, and global communities in which they exist; climate change must be part of the K-16 curriculum.

Research on students' perception of climate change has documented grave misconceptions concerning the scientific basis underlying climate change. For example, students believe that increasing temperatures are the only major effects of global warming (Shepardson et al., 2009; Gowda, Fox, and Magelky, 1997; Kilinc, Stanisstreet, and Boyes, 2008). The current study presented in this proposal was designed to document college students' conceptual understanding of climate change after participation in field research. The field research opportunity exposed student participants to the concept of global climate change and its potential effects on wildlife, specifically the ecological disturbance of broad-scale tree mortality related to the mountain pine bark beetle (***Dendroctonus ponderosae***). The least chipmunk (***Tamias minimus***) was used as a model species because it is ubiquitous to the landscape but has a strong affiliation to pine forests.

Study Design

Student Population and Study Site: Thirty-six undergraduate students at the University of Wyoming participated in this study. The field research experience took place in the Pole Mountain area of Southeast Wyoming in late summer and fall of 2012 over a three-week period. Students participated in setting the trapping grids, opening and closing traps daily, checking traps, providing support during handling (e.g., data recording, and equipment handling), as well as help releasing the animals post processing at the capture location.

Methods: This mixed methods study implored both quantitative (7-point Likert scale survey) and qualitative (semi-structured interviews) data collection. Students were given pre/post Likert scale assessments documenting variables concerning climate change**,** science self-efficacy and attitudes towards science, and career choice. For the purposes of this proposal, only data concerning student conceptual change of climate change was analyzed. Students were chosen to be interviewed based upon pre/post survey answers.

(Note: As of the submission date for this proposal only the pre survey has been given and analyzed.)

Analysis:

Responses to the survey questions were entered into an excel spreadsheet with a corresponding numerical code to the 7-point Likert scale (1=strongly agree, 2= agree, 3=somewhat agree, 4=neutral, 5=somewhat disagree, 6=disagree, 7=strongly disagree).

Using Microsoft excel, data was analyzed and descriptive statistics completed.
Comparative analysis will be run on the items from the survey between pre and posttests.

Findings:

Of the thirty-six student participants, 3% reported being very informed of climate change concepts; 33% reported somewhat informed; 53% reported being informed and 11% reported not being informed of climate change concepts. In regards to whether or not climate change is actually occurring on a global level, participants agreed that it was.

They also agreed that climate change is an important issue to discuss and one to develop a deep understanding of. Students also reported agreeing that: (a) climate change is a significant conservation challenge; (b) climate change will have a negative impact on wildlife; and (c) increases in temperatures from climate change is the primary cause of bark beetle population increases in Southeastern Wyoming.

Discussion

According to pre-test analysis, students feel that increases in temperature is the primary cause of ecological changes. However, do these participants have a deep understanding of the impact of climate change on population dynamics? If not, we believe that participating in filed research will allow for a more focused conceptual change, than classroom instruction alone. Even if students have a firm grasp of climate change, seeing changes to populations and ecological relationships will be strengthened through this outdoor learning opportunity. Situations that arise during the field research experience will force participants to use science processing skills and content knowledge concerning climate change. The use of both proves skills and content knowledge allows students to deconstruct misconceptions and scaffold new knowledge within existing schemas. Such outdoor learning experiences are necessary in K-16 education, so that citizens are able to make informed decisions about global climate change.

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Open Inquiry-Based Science Learning in an International Field-Course: Students as Research Scientists and Global Citizens

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Providing opportunities for undergraduate students to participate in authentic research experiences supports the current movement to transform undergraduate science education at both the classroom and institutional levels in the United States. Designing programs that allow participants to conduct authentic scientific research while working outdoors in the field is a key component of achieving this goal while simultaneously enhancing scientific literacy in 21st century environmental realities. The aim of this study is to assess how an international field course in Panama in conjunction with the Smithsonian Tropical Research Institute (STRI) influenced participants' understanding of and engagement in authentic science practices, as well as their understanding of and engagement with global environmental stewardship. Preliminary results reveal several broad and encouraging emergent themes. The overarching theme being the following: conducting authentic scientific research alongside real-world research scientists provides participants with the chance to be field scientists investigating critical environmental issues, and as a result of the field experience participants are motivated to take the next steps in moving our planet in the direction of global sustainability - either by playing the part of citizen scientist and/or entering into a career path to become a field researcher.

Subject:

Global environmental sustainability and public understanding of science are now more critical than ever. Scientific literacy is therefore an imperative educational goal in order for nations to move jointly in the direction to protect and preserve what is left of our living planet. A key element in establishing a scientifically literate society is to teach science via the lens of a researcher – on a global scale. Essential to this formula is the use of scientific inquiry at levels that allow learners to think and act like scientists, and to do what a scientist does. Equally important is providing learners with opportunities to experience global environmental sustainability in action. Designing programs that allow participants to conduct authentic scientific research in the outdoors in the field is a key component of achieving the goal of scientific literacy. Additionally, in 2009, the American Association for the Advancement of Science (AAAS), with support from the National Science Foundation (NSF) published "Vision and Change in Undergraduate Biology Education: a Call to Action (AAAS, 2011) for distribution nationwide. Providing opportunities for undergraduate students to participate in research experiences utilizing innovative and interdisciplinary pedagogical methods supports this current and progressive movement to transform undergraduate science education in the United States.

Constructivist learning environments, including outdoor field experience, in science are created when experiences are designed to be "active, hands-on, lab-rich, curricularly lean, connected to contexts, and enmeshed in a community of learners" (Wubbels & Girgus, 1997; Bettencourt, 1993). Field-based learning provides just such an environment, and is ideal for constructivist learning that promotes deep scientific understanding in biodiversity and conservation biology. In particular, the "Field Course Experiential Learning Model" (Zervanos and McLaughlin, 2003; McLaughlin and Johnson, 2006) evolved from repeated short-term study abroad field course experiences in selected biomes from around the world over a six-year period. Assessment of student learning guided the development of an integrated course model featuring three steps: 1) innovative online pre-trip assignments that provide essential background knowledge; 2) a field-based trip experience (two to three weeks in duration) that includes hands-on conservation experiences, ecosystem exploration, journal keeping, “open inquiry-based” research experiences, participation in discussion groups, and independent exploration; and 3) post-trip Web-based assignments that encourage the integration and application of key concepts learned as well as relevant reflection. This design facilitates increased understanding of biodiversity and conservation biology while encouraging students to become active participants in their own education

The aim of this study is to assess how an international field course influenced participants' understanding of and engagement in authentic science practices, as well as their understanding of and engagement with global environmental stewardship. More specifically, this study poses the following research questions:

In what ways do CHANCE participants see themselves as capable of conducting authentic science?

In what ways did participants increase their engagement in global environmental stewardship activities as a result of completing the CHANCE field course?

Study Design: This study is derived from a larger program evaluation and utilizes a variety of data sources in order to answer the above research questions. These sources include students' field journal entries, post-course surveys, and post-course reflective essays. The data are both quantitative (Likert scale survey) and qualitative (journal entries and essays). Simple descriptive statistics is used to analyze the survey data while a constant comparative method of analysis is being applied to the qualitative text.

The Penn State CHANCE program (Connecting Humans And Nature through Conservation Experiences) has been making its mark by empowering environmental education through scientific research for years (www.chance.psu.edu). Through this professional development and outreach program, participants can travel the world – either physically or virtually - to carry-out real-world research on some of the world's most troubling environmental issues to gain experience in research, learn the importance of global environmental sustainability, and to become scientifically informed global citizens. This study focuses on CHANCE's international embedded field courses for undergraduates and K-12 teachers; and more specifically, assessment of its recent field course, ***Global Climate Change: Sustainability of Select Tropical*** and ***Aquatic Ecosystems - A Field Practicum in Panama***. This course set out to immerse participants in worldwide realities and research experiences that address the "Taking Action on Climate Change" environmental priority set forth by the United **States Environmental Protection Agency (EPA).** Participants studied global climate change online during the spring semester of 2012 followed by fieldwork in Panama for 17 days in July 2012. The field practicum provided a hands-on workshop on inquiry-based learning by education specialists and real-world research and conservation experiences that were chaperoned by scientists at select **Smithsonian Tropical Research Institute (STRI)** field stations– the latter focusing either directly, or indirectly on the effects of global climate change on ecosystem biodiversity and dynamics. There were 19 participants: 15 undergraduate biology majors, 1 undergraduate science education major, and 3 K-12 teachers. Their ages ranges from 19-45. There were 9 males and 10 females.

Findings: The research team is currently in the process of analyzing the data. Preliminary results reveal several broad emergent themes. Participants perceived the real-world research experiences with STRI scientists in the field as having provided them with: 1) an increased understanding of the practices of science (i.e. asking questions, designing and implementing research, communicating research); 2) exposure to the career of "research scientist" itself, and how higher education and governmental and non-governmental organizations are essential players to this career; 3) a reality-check, if you will, in that they came to the realization through their own mental and physical hard-work, that scientists that work in the field are committed ***and*** amazing individuals; 4) a feeling like they were real scientists and empowered because they could think like one; 5) an appreciation for how high-level scientific inquiry is essential to research; and, 6) the motivation to engage in future environmental field research and/or environmental stewardship activities.

Discussion & Conclusion: Based upon the preliminary results, the CHANCE field course has had a substantial impact on the participants' understanding of and engagement in authentic science practices, as well as their understanding of and engagement with global environmental stewardship. Conducting authentic scientific research in Panama alongside Smithsonian scientists provided participants with the chance to be field scientists investigating critical environmental issues, and as a result of the field experience participants are now taking the next steps in moving our planet in the direction of global sustainability either by playing the part of citizen scientist and/or entering into a career path to become a field researcher.

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Design strategies for supporting scientific explanation and argumentation about ecosystems

Brian J. Reiser

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Overview:

The project goal is to make scientific practices a central part of building, refining, and applying knowledge to real world problems, and to ground the scientific knowledge students develop on their own personal experiences in the natural world. I outline our current approaches to help students develop explanatory models of population interaction in ecosystems and apply these models to a range of classroom experiences, secondary datasets, prior personal experiences with the natural world, and designed experiences involving outdoor learning. To date, an emphasis on scaling up our curriculum solutions for widespread use has led to a greater focus on supports for implementation in classrooms than on activities involving the outdoor learning environment. I am eager to explore collaborations through the ICOLE workshop to extend our integration of outdoor and classroom learning environments.

The Need for Coherence in Science Learning:

A central emphasis on reforms in science learning is the need for greater attention to coherence. For example, in the U.S., the national Research Council Framework for Science Education (2012) calls for (a) narrowing learning goals to core explanatory disciplinary ideas; (b) helping students develop these ideas by engaging in scientific practices to construct, apply, and refine them; and (c) support for incremental building of these ideas across time, linking application of scientific ideas to multiple contexts. Thus, the Framework focuses on the need for coherence --systematically revisiting the core ideas in new contexts across time to apply, extend, and develop more sophisticated versions of these ideas. One important aspect of coherence involves helping students link the science ideas developed in the classroom to phenomena in the world around them.

My research focus has been the development of classroom curriculum materials to support students in scientific explanation and argumentation of central explanatory ideas, using real-world contexts to help students connect their explanations to both classroom and real-world phenomena. IQWST (Investigating and Questioning Our World Through Science and Technology) is a coordinated curriculum series that involves learners in investigation and model building to develop disciplinary ideas in depth (Krajcik, McNeill, & Reiser, 2008). In IQWST, students engage in repeated experiences across three years (grades 6-8) to construct and refine explanatory models, arguing from evidence to compare, critique models, and reach consensus.

Supporting Explanatory Models:

In each IQWST unit, each 6-8 week investigation is organized around a driving question. The driving question is introduced by the teacher, guided by the curriculum materials, and motivated by real-world experiences and classroom phenomena. The IQWST unit on ecosystems investigates the general driving question What can cause populations to change? Students investigate this question by starting with a particular problem scenario, the decline of the trout population in the U.S. Great Lakes across several decades.

Students build their argument from evidence in the investigation, developing new questions as needed. Thus, teachers support the students through a series of investigations, in which pursuing the general explanatory question leads to more specific questions motiving particular investigations such as Where do living things get the food they need?; What happens when a food source disappears?;

What interactions can living things have with one another?; and then finally How does a change in one population affect another population in the ecosystem? Each step is organized around a question that teachers develop with students. In the trout case, students consider candidate explanations involving the trout's food source, changes in the trout's predators, the influx of an invasive organism (the sea lamprey), and abiotic factors such as increasing dioxin in the Great Lakes. The full argument explains the trout's decline due to a two-pronged effect of sea lamprey on the trout (both as a predator and as competitor for the trout's prey), along with a secondary effect of increased dioxin in the lake. The students' arguments support their claims with evidence from the trout data and analogous cases, and draw on the general models they have constructed about population interactions.

The curriculum materials support students in developing models to explain the cases they investigate, apply the models to new cases, and revise them as needed to address new phenomena (Schwarz, et al., 2009). This requires continued negotiation between the particulars of each case and general explanatory models. Students use the initial problem scenario for the trout decline to generate questions about different types of population interactions, including how change in a prey population can affect a predator, how changes in a predator population can affect its prey, and how introduction of a new organism that competes for the same prey can affect the population. Students explore these questions using model food webs in the classroom, and then investigate computer simulations that enable them to alter population levels and construct the idea of competition for limited resources. Students apply these ideas, constructed in specific cases, to form more general models of interactions that they can then apply to population data from the trout secondary dataset. In this way, students generalize from specific cases to more general models, and apply these models to new specific cases. The trajectory of cases and generalizations helps students develop connected understandings, in which explanatory ideas such as indirect effects in food webs and competition for limited resources are constructed and applied to historical cases (using secondary datasets), applied to contemporary cases in the news media, connected to phenomena that can be experienced in the classroom (such as classroom habitats), and connected with students' own prior real-world experiences.

The challenge of integrating classroom learning with outdoor learning environments is another aspect of achieving coherence. Outdoor learning environments present a rich set of experiences that can help students connect scientific ideas to their own experiences. There are several ways we integrate outdoor learning experiences within the investigation. One strategy is to build on the types of organism interactions students investigate through classroom phenomena and secondary datasets with investigation of the natural world outside the classroom. Students conduct a "neighborhood field study" to attempt to identify cases of organisms interacting with one another, and with their environments. Students sketch or photograph the interactions, and record field notes about the type of interaction and the specific evidence for this interaction. For example, students might observe squirrels and rabbits eating fruits, nuts, or plants, or find evidence of partially eaten fruit or nuts and hypothesize squirrels or rabbits as the cause. They might identify a habitat for insects or holes in a yard that appear to be dug by some type of animal. The activity is useful for sensitizing students to the range of interactions possible in the natural world even in suburban and urban environments. In this way, the outdoors learning activity both applies the initial ideas students have constructed in the classroom, and generates further questions that can be addressed in the classroom investigation.

We are now investigating a second type of activity to support students in collecting observations that can generate questions about ecosystem interactions. In this activity, students use motion-detecting field cameras (camera traps) that automatically collects time-stamped images when animals pass nearby to develop and investigate questions of animal behavior in their neighborhood. We piloted this activity with a classroom of 5th grade students, and are now incorporating the activity into the IQWST ecosystem investigation. We use camera traps to help students become more thoughtful about formulating questions amenable to empirical investigation of ecosystems. In the pilot, students discussed the diversity, abundance, and behavior of animals in their neighborhood. Students designed investigations using motion-sensor cameras to study what animals were around in their neighborhoods and how they interacted with their environment. Students formulated research questions they could explore using these cameras, e.g., about the time of day various animals appear or what behaviors they would exhibit. Students took the cameras home and collected data for several days. After comparing captured images, the class conducted a second round of data collection, focused on maximizing the number of non-domestic animals captured in images through the effective setup of the cameras, selection of locations likely to contain animals, and use of bait. Common wild animals observed included squirrels, opossums, and rabbits. Students generated questions about morphology, diversity, abundance, and behavior. While most questions were descriptive rather than explanatory, the proportion of comparative questions increased in the second round of data collection. We expect that integrating this activity into the longer-term investigation of ecosystems in IQWST will provide a richer context for students to generate and explore explanatory questions, and to apply the models they are building about population interactions to make sense of their observations in their local environment.

There are a number of design challenges raised in integrating classroom work in science with investigations in outdoor learning environments. In general, students have come see science as a separate body of knowledge, kept apart from everyday sensemaking. Studies of attempts to connect formal and informal learning, such as learning in outdoor environments, museums, and science centers, have shown the students typically fail to work through the connections between what they are learning in these out of school environments with their work in the classroom (Anderson, Piscitelli, Weier, Everett, & Tayler, 2002; Storksdieck, 2001). Supporting students in building more coherent, less compartmentalized knowledge, requires ongoing support and a shift in epistemology to adopt the commitment of attempting to apply explanatory models to make sense of new phenomena whether they arise from classroom activities, prior commonsense knowledge, and new experiences in the world outside school (Schwarz, et al., 2009; Schwarz, Reiser, Kenyon, Acher, & Fortus, 2012).

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The Historical House Worksheet

Take 15 minutes for exploring the historical museum and try to learn about the person who lived in the house. Support your conclusions by your direct observations.

A. From observations to conclusions

1. What were this person's main activities?

Observations	Conclusions

2. What can you learn about the historical period of time when this person lived here?

Observations	Conclusions

3. What can you learn about the personality of the person who lived here?

Observations	Conclusions

4. Additional details that you learned about the person who lived here:

Observations	Conclusions

B. Strengths and weaknesses

1. Consider the historical museum as a learning environment that is an integral part of the school curriculum. What are its strengths?..

....

....

....

....

2. Consider the historical museum as a learning environment that is an integral part of the school curriculum. What are its weaknesses?..

....

....

....

....

Monday – February 4, 2013

07:00	*Breakfast*
08:30	Traveling towards **Mizpe – Ramon** area
10:30	**Outdoor demonstration:** Machtesh Hatira geological site
11:45	**Sde-Boke**r Environmental high school
12:15	*Lunch break*
14:00	Arriving at **Mitzpe Ramon Inn** and getting settled
14:15	*Coffee break*
14:30	**Interactive session** » **A. Kristiansen:** Outdoor Studies in the Sub-Arctic: How to grow robust teachers on trees! » **D. Schmidt, A. Lindau and M. Lindner:** Could the experience of wilderness change attitudes towards wilderness? A design concept for an advanced training of multiplicators for pre-service teachers of geography and biology in wilderness camps » **C. Ormond, D. Zandvliet, V. Elderton, B. Ford, J. Jenkins and V. Lee:** Outdoor environments and environmental learning: Program experiences in a place-based teacher education course at a Canadian University. » **C. King:** Interactive Earth science fieldwork – four examples » **H. Esteves, C. Vasconcelos, I. Fernandes and D. Rodrigues:** Environmental Education Fieldtrip on the left bank of the river Minho (Portugal)
16:30	Free time for walking along the Machtesh promenade.
19:00	*Dinner*
20:00	**Plenary session** **Dr. Molly Yunker:** Ideal to Real: the Transition from Perfect Settings to Imperfect Environments

The Rock Cycle in Machtesh Hatira

Nir Orion

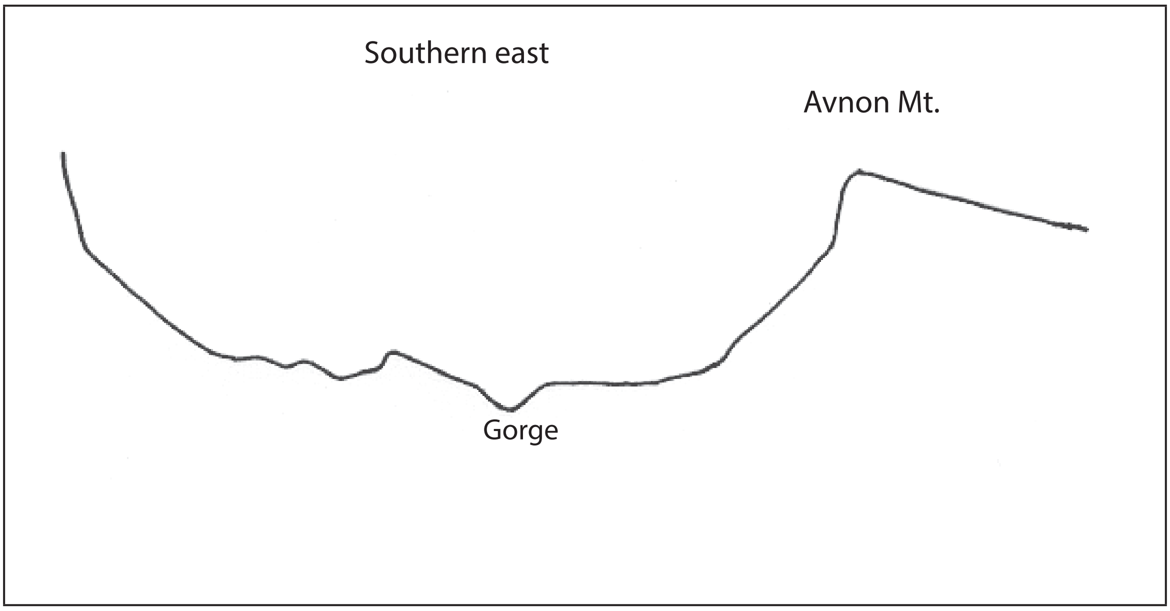
Stop 1: Mt. Avnon - The Machtesh view

A. The topography

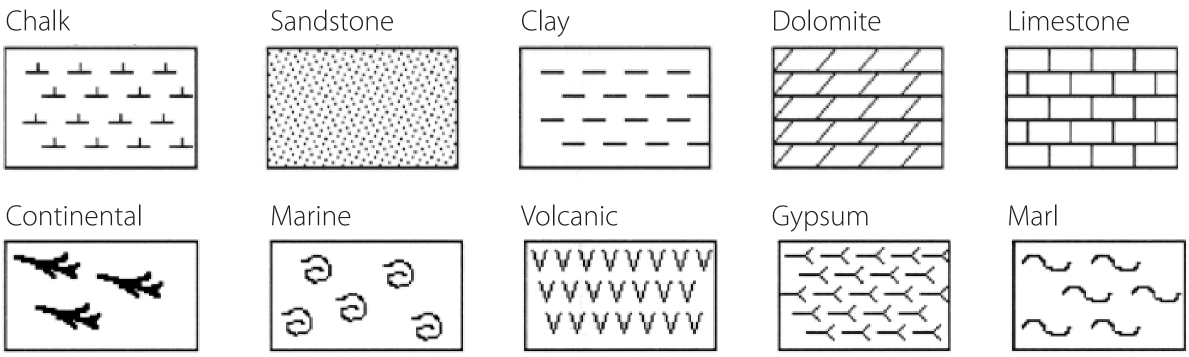
1. Below is a topographical cross section of the Machtesh's wall from Mt. Avnon to the Hatira gorge.

   » Look to the south and try to recognize the following view formations: cliff, slope, gorge.

   » Mark those formations in the right place on the topographical cross-section below.



Legend



B. The geology

1. Observe the rock that builds the cliff

- What phenomenon can tell you that this rock belongs to the group of rocks known as sedimentary? ....
- Are the rock's layers horizontal or tilted? ....
- What can you conclude from the above observation concerning the layers? ....
  ....
- What is the geological principle that your above conclusion is based on? ....
  ....

2. A closer look

- Please approach the rock's exposure and collect a specimen of this rock.

Use the following table to identify the rocks composing this outcrop.

Properties	Observations (circle)	Conclusions
Layers	Exist/does not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumbles / Does not crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron / not even by iron	
Crushing by teeth (Only for a crumble rock!)	Can be crushed / cannot be crushed	
Mouldability (while wet)	can be molded/cannot be molded	
Reaction to *HCl* (6%)	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name:

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report.

3. Why, in your opinion, does this rock create a cliff formation? ....

....

4. Notice the moderate slop of the bottom of the Machtesh wall. What might be the reason for this phenomenon? ....

5. To which direction are the layers that build the cliff tilted (circle)? *East / West*

6. In order to turn the topographical cross-section of page 2 to a geological cross-section, please add to it the layers that you observed here: their direction and type of rock.

Monday

C. Fractures of rocks

- Look at the fractures of rocks that appears on the slope (confirm with the teacher that you're looking atthe right phenomenon).

1. What is the roundness factor of the fractures (circle)? Angular / sub-rounded /rounded
2. Following your above observation, what is your conclusion concerning the transportation distance of these fractures? ....

   ....
3. Which stages of the rock cycle might be identified through the observations you made throughout the whole activity (circle)? *Melting / crystallization / uplifting / exposure / erosion / weathering / transportation / sedimentation / cementation / burial*

Don't forget to take pictures of meaningful phenomena for your report.

D. The environment of formation

In order to reconstruct the environment of formation of the rocks that build the cliff, we'll go back and look for a guiding phenomenon on the slope behind the parking lot.

1. The phenomenon is: ....
2. How can this phenomenon tell us about the environment of formation of the rock? ....

   ....
3. Which stages of the rock cycle might be identified through the observations you made throughout the whole activity (circle)? *Melting / crystallization / uplifting / exposure / erosion / weathering / transportation / crystallization of minerals to build skeletons / dissolution / crystallization of minerals from sea water / marine sedimentation / river sedimentation / lake sedimentation / cementation / burial*

Don't forget to take pictures of meaningful phenomena for your report.

E. Earth systems

- Which relationships among the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all four sections)?

Questions that were raised following the activity:

Remarks and comments:

◉ Stop 2: The rock in the bottom of the Machtesh wall

A. Rock and landscape

1. Are the rocks' layers that appear here younger or older than the layers that we observed in the upper part of the cliff? ....

....

2. On what geological principle is your answer based? ....

....

- Please approach the rock exposure and collect a specimen of this rock.

Use the following table to identify the rocks composing this outcrop.

Properties	Observations (circle)	Conclusions
Layers	Exist/does not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumbles / Does not crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron / not even by iron	
Crushing by teeth (Only for a crumble rock!)	Can be crushed / cannot be crushed	
Mouldability (while wet)	can be molded/cannot be molded	
Reaction to ***HCl*** **(6%)**	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name:

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report.

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

B. The environment of formation

- Look for a guiding phenomenon that will help you to reconstruct the environment of formation of this rock.

1. The phenomenon is: ....

2. How can this phenomenon tell us about the environment of formation of the rock? ....

3. Which stages of the rock cycle might be identified through the observations you made here (circle)? *Melting / fast crystallization of a magma / slow crystallization of a magma / uplifting / exposure / erosion / weathering / transportation by wind / transportation by the sea / transportation by river / river sedimentation / dune sedimentation / marine sedimentation / lake sedimentation / cementation / burial*

Don't forget to take pictures of meaningful phenomena for your report.

C. Earth systems

- Which relationships among the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all four sections)?

....

....

....

Questions that were raised following the activity:

....

....

....

....

....

....

Remarks and comments:

....

....

....

....

....

⦿ Stop 3: The rock that forms the center of the Machtesh

A. The rock

1. Are the rocks' layers that appear here younger or older than the layers of the Machtesh wall?

....

2. On what geological principle is your answer based? ....

Use the following table to identify the rock composing this outcrop.

Properties	Observations (circle)	Conclusions
Layers	Exist/does not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumbles / Does not crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron / not even by iron	
Crushing by teeth (Only for a crumble rock!)	Can be crushed / cannot be crushed	
Mouldability (while wet)	can be molded/cannot be molded	
Reaction to *HCl* **(6%)**	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name:

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report.
Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

B. The environment of formation

- Look for a guiding phenomenon that will help you to reconstruct the environment of formation of this rock. Hint: which of the fossils that appears in the next page can you find here?

1. The phenomenon is: ....

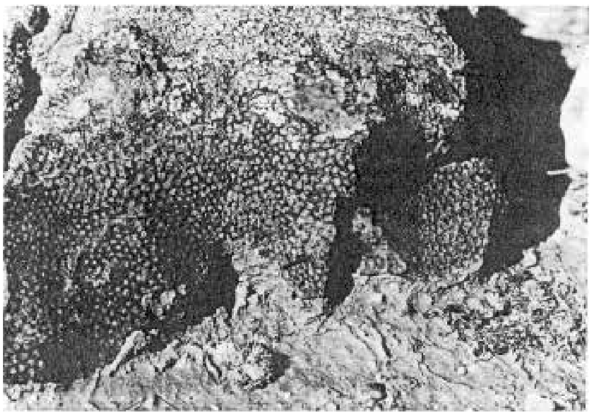
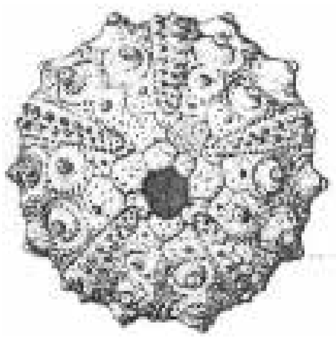
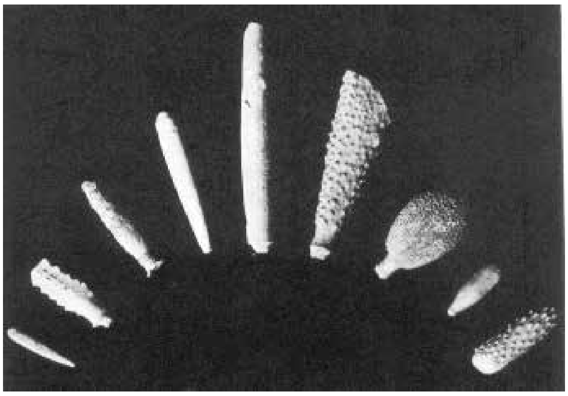
2. The environment of formation of the rock is (explain): ....

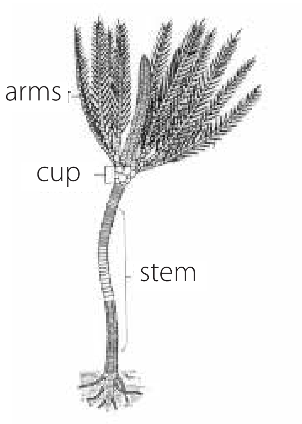
....

3. Which stages of the rock cycle might be identified through the observations you made here?

....

Don't forget to take pictures of meaningful phenomena for your report.

Corals	
 Isolated Coral	 Coral Colony (in situ)
Sea Echinoderms	
 Body of a Sea Urchin	 Different Sea Echinoderms - Jurassic age



C. Earth systems

- Which relationships among the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all four sections)?

Questions that were raised following the activity:

Remarks and comments:

⦿ Stop 4: The southeast wall of the Machtesh

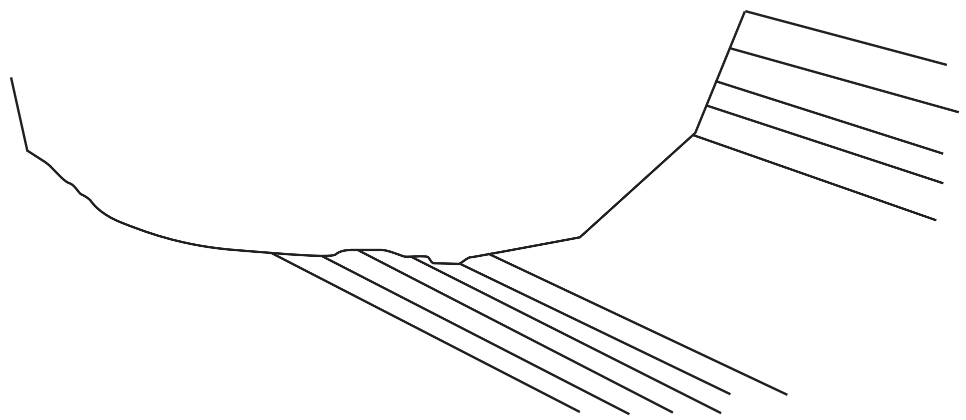
A. Rock and landscape

1. Look at the rocks that build the wall of the Machtech here. To which group of rocks do they belong? Explain your answer: ....

2. Are they in their original position? Please explain your answer: ....
....

3. To which direction are the layers declined here (circle)? *East / West*

4. Add to drawing below the part of the topographical cross-section that we could not see from Mt. Avnon.



B. The Rocks of the southern east wall

1. Use the following table to identify the rock of the upper part of the cliff.

Properties	Observations (circle)	Conclusions
Layers	Exist/does not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumbles / Does not crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron / not even by iron	
Crushing by teeth (Only for a crumble rock!)	Can be crushed / cannot be crushed	
Mouldability (while wet)	can be molded/cannot be molded	
Reaction to *HCl* **(6%)**	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name:

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

2. Use the following table to identify the rock of the bottom of the cliff.

Properties	Observations (circle)	Conclusions
Layers	Exist/does not exist If exist: Horizontal/tilted	
Color		
Crumbling	Crumbles / Does not crumble	
Hardness (Only for a non-crumble rock!)	Can be scratched by: fingernail/ only by iron / not even by iron	
Crushing by teeth (Only for a crumble rock!)	Can be crushed / cannot be crushed	
Mouldability (while wet)	can be molded/cannot be molded	
Reaction to *HCl* **(6%)**	Very bubbly /slightly bubbly/ no reaction	
Additional observations		

Rock's name:

Go back to the geological cross-section of page 2 and add to it the layers that you observed here: their direction and type of rock.

Now you have a complete geological cross-section of Machtesh Hatira!

Monday

5. Please use the following table to compare between the rocks' strata of northwest wall (Mt. Avnon) and the southeast wall.

	The southeast wall	The northwest wall
Similar		
Different		

Don't forget to collect a specimen of rock and to take pictures of meaningful phenomena for your report.

C. Reconstruction of the geological history of the Machtesh

1. Reconstruct the geological structure of the Machtesh: Go to the cross-section that you prepared and continue the inclination of the upper layer from both side with a dashed line until the two lines meet in the middle.
2. What type of a geological structure was created (circle)? *Anticline / Syncline*
3. Connect the other layers with dashed lines as well.
4. Which geological process should took place in order to change the structure that is drawn by the dashed lines to the landscape that appears today?..

   ....

   ....
5. How many stages of the rocks' cycle you might identify following your observations in this stop?

   ....

   ....

   ....

   ....

Don't forget to take pictures of meaningful phenomena for your report.

D. Earth systems

- Which relationships among the earth systems: geosphere, hydrosphere, atmosphere and biosphere (including man) might be identified in this stop (including all four sections)?

Questions that were raised following the activity:

Remarks and comments:

Outdoor Studies in the Sub-Arctic: How to grow robust teachers on trees!

Anne Kristiansen

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People might look to Norway for our long traditions when it comes to practicing outdoor life, but we are moving in the same direction as many other Western countries: adults and children are spending less and less time outside in nature, especially the young generation. University of Nordland offers "Outdoor Life and Science", 30 ECTS, for pre- and primary schools teacher students. The interdisciplinary course puts a great emphasis on the integration of physical development and the natural sciences. Its main philosophy is that secure adults will act as inspiring role models and create better learning opportunities for children. The students are taught to master the outdoors and see possibilities for learning activities in all four seasons. Place based learning is an important approach on how to utilize the local environments. During the course students experience how natural and cultural landscapes can give "authentic" learning situations and increase quality in the interdisciplinary outdoor teaching. After the course the students should have both practical skills and professional knowledge of natural science, physical development and how children play in nature.

A group of former "Outdoor Life and Science" students will be interviewed autumn 2012 to see if they use nature as an arena for physical development, learning and real life experiences for children in pre-schools.

Subject:

International research has documented a reduction in the mobility of children within their own neighborhoods because of:

- stress related to family schedules.
- the weakening of bonds with neighbours and with wider social networks.
- increased distances between villages and nature areas.
- the disappearance of green areas.
- the loss of spaces suitable for unstructured natural play.
- increased traffic.
- increased anxiety among parents about crime and accidents.

Norwegian research has shown that the characteristics of children's everyday life when using nature in their local environment are changing:

- Children are spending increasing amounts of time in institutions such as kindergartens, schools, and before- and after-school care.
- Much of their free time is now occupied by organized, planned and adult-controlled activities.

Thus, children spend more time inside. Almost one of five Norwegian children between 6 and 12 years is obese. Inactivity might be one of the important explanations. So, can nature be a good arena for physical development, learning and real life experiences for children in pre-schools? And could nature-based activities in pre-schools foster interest in being active in nature later and thus give better adult health?

We need pre- and primary schools teachers as confident facilitators for children's' learning in and about nature. If we can establish a greater sense of safety in nature amongst educators, and provide them with examples, tools and techniques, they could potentially have more motivation to take children outside for learning and experiencing the real world. We should also search the curriculums for possibilities for outdoor teaching.

Study Design:

During the autumn of 2012 I have planned to interview former students of Outdoor Life and Science about how they facilitate outdoor life and natural scientific activities for children when working in Norwegian pre-schools. Through a questionnaire I want to find out if their teacher training has given them relevant knowledge, tools and techniques in their working life. This information will be used to improve the course "Outdoor Life and Science".

The Power of Wilderness
Could the Experience of Wilderness Change Attitudes towards Wilderness?
A Design Concept for an Advanced Training of Multiplicators for Pre-Service Teachers of Geography and Biology in Wilderness Camps

Daniela Schmidt, Dr. Anne-Kathrin, Prof. Lindau and Martin Lindner

Martin Luther University Halle-Wittenberg, Germany

Monday

Over the last 30 years "wilderness education" has developed as a new concept in national parks and nature conservation areas in Germany. The rising estrangement from nature of children and young people is seen as one reason for the need of wil-derness education (ZUCCHI 2000, FREER 2012). Relating to this, wilderness education can foster the ability to reflect the relationship between human beeings and nature through experiences of wilderness in combination with ecological education. Addi-tionally, it contributes its share to education for sustainable development (LANGEN-HORST 2012).

The concept focuses on rising consciousness of modesty and plainness as the basis of life. LANGENHORST (2012) formulated seven objectives for wilderness education. They describe, for example, the intensive experience in wilderness, which is accom-panied by the development of empathy, the reflection of one´s lifestyle as well as the discovery of biological diversity and its importance for human beeings. The under-standing of interaction between human beeings and their fellow men helps to develop a competent formation of judgment in everyday life. The development of wilderness camps is one opportunity to get to know wilderness education. Those camps are very unpretentious as they are set in a low organized and low civilized surrounding.

Within the framework of teacher-teaching for Geography and Biology, the concept was designed in order to provide pre-service teachers with further education in wil-derness by retraining them from participants of wilderness camps to heads of those camps. In this way teachers should be educated to pass on their ideas of wilderness education to their students.

Subject/Problem:

At present children experience a virtual, passive and electronic childhood. Richard LOUV (2010) provoked by calling this phenomenon "indoor-disease" and regarded it as a reason for the nature deficit disorder. Not only English-speaking countries but also German-speaking countries are making demands on developing and supporting experience in nature (BARUCKER 2010). In this context wilderness camps are able to provide an opportunity to counteract the estrangement from nature by getting to know conceptions of wilderness education.

Hence following research question results:

1. How do pre-service teachers change their concept of wilderness through wil-derness camps?
2. How do pre-service teachers change their attitudes towards wilderness and towards a sustainable lifestyle through wilderness camps?

Study Design:

The design concept for an advanced training of multiplicators for pre-service teachers of Geography and Biology in wilderness camps serves as the basis for the study. During three wilderness camps pre-service teachers can develop from participants to heads of those camps in order to act as multiplicators of wilderness education.

The study will measure an attitude change of pre-service teachers towards wilder-ness and their own lifestyle by taking part in wilderness camps. Beforehand all ideas of wilderness have to be recorded. The following measuring instruments will be used before and after wilderness camps in order to evaluate an attitude change: question-naires with semantic differentials, interviews as well as drawings. In addition, the par-ticipants have to write a "wilderness diary", which will be evaluated by specified crite-ria. The research is based on didactical models of conceptual change and inquiry-based learning.

Findings:

The study showed that the ideas of wilderness are extremely different and partly im-pressed by abstract conceptions, which are influenced by media.

After the first wilderness camp semantic differentials showed that the attitude towards wilderness has changed. Sociodemographic questions revealed that attitude chang-es of pre-service teachers correlate with their family background. The analysis of the wilderness diaries illustrated that personal experiences one the one hand and group activities on the other hand made the greatest impression on the participants.

Brief Discussion:

The evaluation of questionnaires, interviews and wilderness diaries presents that es-pecially the affective component of an attitude, referring to the emotional attitude to-wards wilderness, influenced the attitude change. Most of the pre-service teachers characterized wilderness as an intensive experience with all senses. Some of them indicated that wilderness camps activate to think about their own lifestyle and con-servativeness. This finding corresponds with the target of wilderness camps in the Harz National Park.

Conclusion:

The results of the research question, in what way wilderness camps are able to con-tribute to an attitude change towards wilderness, are summarized as it follows:

1. Wilderness camps can cause an attitude change towards wilderness due to a suit-able concept design for an advanced training of multiplicators for pre-service teach-ers of Geography and Biology.
2. Especially affective experiences in wilderness can lead to attitude changes to-wards wilderness and the own lifestyle of pre-service teachers.
3. Wilderness education can counteract alienation of nature.

In particular pre-service teachers, who grew up in towns or cities, changed their atti-tude to a great extend than those, who grew up in villages or in the country. The study showed that intensive outdoor activities, that take place over a long time, can make a contribution to attitude changes towards wilderness.

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Outdoor environments and environmental learning: Program experiences in a place-based teacher education course at a Canadian University.

Carlos G. A. Ormond[1], David B. Zandvliet[1], Victor Elderton[2], Bruce Ford[3], Jarrid Jenkins[3] and, Vanessa Lee[3]

1. Simon Fraser University
2. North Vancouver Outdoor School
3. Metro Vancouver

Monday

Abstract:

This paper describes a place-based teacher education course at a Canadian university with a focus on the perceived learning environment and experiences of the 28 students registered. The course was an environmental learning course that was conducted at outdoor learning environments throughout the Metro Vancouver region. Data was collected through participant observation and a questionnaire that was both qualitative and quantitative in nature. Of the 27 students who completed the questionnaire, all 27 gave the course the highest possible rank of Very Good; 18 students felt the course did not have any weakness; and lastly, a common comment to improve the course was to have the course last longer in order to extend the learning and add more experiences. The findings from this study acknowledge the transformational element of place-based learning environments in fostering a more community-minded society.

Subject:

The term ***place-based education*** appears to have been coined in North America in the late 1980s, although elements of its practice have been in existence for quite some time (Smith, 2002; van Eijck, 2010). Unlike other pedagogies, place-based education does not have its own theoretical tradition. Rather it shares "practices and purposes… to experiential learning, contextual learning, problem-based learning, constructivism, outdoor education, indigenous education, environmental and ecological education, bioregional education, democratic education, multicultural education, community-based education, critical pedagogy… as well as other approaches that are concerned with context and the value of learning from and nurturing specific places, communities, or regions" (Gruenewald, 2003, p. 3).

A popular appeal of place-based education is the ability it has "to adapt to unique characteristics in particular places" (Smith, 2002, p. 584). This trait of place-based education makes it a strong tool to "overcome the disjuncture between school and children's lives that is found in many classrooms" (Smith, 2002, p. 585). Unfortunately, progressive fields of education, such as place-based education, have had difficulty being integrated into mainstream education. One reason for this is that academic institutions tend to place an emphasis on students' disciplinary content achievement rather than on the classroom (i.e. learning) environment. Focusing solely on content knowledge for evaluations and disregarding affective process, and skill development risks destroying "the human qualities that make education a worthwhile experience for students" (Fraser, 2001, p. 2).

Learning environment research (LER) has provided compelling evidence to suggest that (a) the classroom environment has a strong effect on student outcomes (Fisher & Khine, 2006; Fraser, 2007; 2012; Wang, Haertel, & Walberg, 1993) and (b) actual and preferred student learning environments have a much closer fit in place-based and constructivist learning environments than more traditional classroom-based learning environments (Zandvliet, 2012). In LER, the fundamental question is: What is it really like for students in this environment? (Dorman, 2012).

Simon Fraser University is home to Canada's oldest, most established Summer Institute in Environmental Education. The institute tends to offer two courses each year; one in Metro Vancouver (residential) and another in Haida Gwaii (non residential) (Zandvliet and Brown, 2006). Both offerings of the Summer Institute are intended to provide pre-service, in-service teachers and other educators with an opportunity to consider and explore the educational opportunities and implications of human-environment interactions. The Summer Institute is inter-disciplinary in nature and considers the environment through the perspectives of the natural and social sciences, humanities, economics, and the arts. It also addresses curriculums and educational programming from K-Adult levels. Institute formats provide for a wide range of field experiences, seminars, lectures, volunteer opportunities, and hands on activities. This study describes the course in the Metro Vancouver region.

Study Design:

The participants of the study were 28 students registered in the Metro Vancouver institute. Data collection protocols were qualitative in nature using questionnaires, online social network, and participant-observation. The model used for the involvement of all participants in this study follows a participatory research methodology, which allows for the participants of the study, to be co-investigators and co-creators of knowledge in this research (Selener, 1997).

Findings and Discussion:

The Metro Vancouver institute was given a theme to act as an overarching framework for the content of the course: ***Exploring cultural and practical diversity for environmental learning***. As written in the course's syllabus:

There are multiple views held by educators regarding what might constitute environmental education, ecological education and/or education for sustainable development. Diversity in environmental learning is compounded when one considers the various cultures, practices and research that informs the field. This complexity accounts for a range of forms for learning whether it occurs in formal, informal or non-formal contexts. Cultural diversity is often talked about in educational circles, and it is assumed that great benefits are to be gained by educators through careful attention to the full range of perspectives that the world has to offer. In terms of curriculum content, pedagogy, and practice, there is a good deal of evidence that, in order to be more responsive to the needs of diverse populations, program developments here in BC, and around the world need to reflect the variation in our society. This year we invite you to explore the diversity present within the field of environmental learning, both culturally and practically.

The course was organized in six 'modules'. A module is defined here as the theme and programming for a specific week. Therefore with six modules the course's duration was six weeks. The modules were never alike, and based at five different learning environments. This location each week framed the theme for its respective module.

The first module was titled ***Education 'In', 'For' and 'About' the Environment*** and occurred at SFU's Burnaby campus and then at a First Nations replica longhouse on the North Vancouver Outdoor School (NVOS) campus located in a small town two hours from downtown Vancouver. At SFU's Burnaby campus community educators from Metro Vancouver led outdoor-based activities, taken from a Metro Vancouver education resource, titled ***Get Outdoors***, in the green spaces found on campus. Metro Vancouver is a "political body and corporate entity operating under provincial legislation as a 'regional district' and 'greater boards' that deliver regional services, policy and political leadership on behalf of 24 local authorities [; it is comprised of] 22 municipalities, one electoral area, and one treaty First Nation" (Metro Vancouver, 2012). The next day, students met at NVOS with the plan of spending the night in the First Nations replica longhouse. The programming for this retreat included learning traditional Coast Salish practices from two informal educators from a Coast Salish band. In addition, students were introduced to the British Columbia Ministry of Education's Environmental Learning and

Experience (2007) curriculum guides, and their potential use to support the inclusion of outdoor-based learning environments into their practice.

The second module was titled ***Managing a Slippery Resource*** and took place at the Lower Seymour Conservation reserve, which is a Metro Vancouver regional park that acts also to protect one of the regions water reservoirs. With the support of Metro Vancouver educators, the experiential activities and dialogue in this module's programming was focused on the local and global issues surrounding water usage (specifically over-usage) and its affect on the larger ecosystem, such as the life cycle of pacific salmon. A number of activities were borrowed from the international water education resource ***Project Wet***, and took place at the Seymour River Fish Hatchery and Education Centre run by the Seymour Salmonid Society.

The third module was titled ***The City as a Living Organism,*** and was based at SFU's downtown Vancouver campus. The majority of the focus for this week was learning from the urban environment (i.e. from your own community). Students took part in an activity called ***Community Mapping***, which asks the students to go into particular community and through the means of observation and interviews present to the group what they learned from and in those communities.

The fourth module was titled ***Social Justice and Community Work.*** Here students were presented the work of an organization that dedicates its time to running social programs both in the region, and internationally in developing countries. In addition, students were given two days to do volunteer work with a community group of their choosing. Students worked at numerous organizations that were focused on environmental and social justice, and/or youth programming. The objective of this module was to develop the ethic of giving back and investing in one's own community; in such a way one begins to be the change they want to see in the world, to quote Ghandi.

The fifth module was titled ***Land Use Issues – Living With What We Have***. This week had the students visit three locations: Kent Transfer Station; Annacis Island Water Treatment Plant; and lastly, Iona Beach. Kent Transfer Station showed students where their garbage is taken after it is picked up from their homes. Annacis Island Water Treatment Plant showed students where their water sewage goes after it is flushed. Iona Beach showed the students the location of the outflow pipe carrying their treated water sewage out to the ocean. Here the objective was to awaken students from the 'out of site, out of mind' syndrome many of us have living in the city with regards to our waste.

The sixth, and last module, was titled ***Putting it All Together*** and took place back again at the North Vancouver Outdoor School. The students led this last week presenting a portfolio on their experiences during the course. The portfolios were structured around the ***Three P's: Personal, Practical and Philosophical***. Some students wrote songs depicting their learning, and others developed outdoor learning lesson plans. This took place over 3 days and 2 nights at NVOS. On the last day, students were asked to provide input: one via a large group conversation, and the other by a SFU course evaluation. Of the 28 students in the course, 27 students completed the evaluation form. In all 27 evaluations the quality of the students ranked this course 1. Very Good, on a Likert Scale of 1-5, with 1 being the highest. Numerous students commented that the strongest feature of this course was that it was not classroom-based, and was experiential:

> *"The strongest features of this course was how the program was place-based and community-based!"*
>
> *"This course was fantastic. Meaningful learning happened every day."*
>
> *"[The instructors] backed off and let us experience it vs. tell it"*
>
> *"Based in the community, experiential, relevant, and student-centred"*
>
> *"Field experience and community were the strongest features. This course changed me."*
>
> *"One of the best courses I've ever taken! It has completely changed the way I think and do education. I'm inspired!"*

When students were asked to consider the weakest features of the course, of the 27 students who completed the form 18 students said that there was not one. Of the 9 other students, a common weakness was that they wish the course was longer to enjoy the experience longer:

"This course should be offered more often"

"Not enough time!"

"The short and compressed format of the course makes it more difficult to process everything before the portfolio – but it's a process and will continue beyond this course."

Lastly, students were asked if they had any recommendations to improve the course. Again, a comment that came up numerous times was to have the course last longer, not per se to improve the learning but for the learning to be extended:

"Opportunity to extend the length of the course to offer more experiences."

"I would recommend for this course to be longer. I would have loved to have all the learning to sink in over a whole semester."

"I would make it longer because it was so amazing. I wish more of my courses were like this."

One constructive criticism in particular embodied the sentiments of many students in this course after having been conditioned to outdoor learning experiences:

"I really enjoyed [the course]. Well, except for [module] 4 when we were in the classroom. I think everyone was surprisingly bored."

Conclusion:

The findings from this study have much to give to the fields of place-based education, teacher education, and outdoor learning environments. There is no denying "that schools can serve as vehicles for transmitting alternative social and cultural values and practices" (Smith, 2007, p. 189). Therefore, as Smith (2002) argues "the challenge lies in finding ways to alter regularities that constrain the introduction of teaching and learning approaches that could contribute to the potentially revolutionary shifts in cultural beliefs and practices that may be required if the goals of social justice and ecological sustainability that inspired the early proponents of environmental education are to be realized" (p.190). This work aims to do just that.

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Interactive Earth science fieldwork – four examples

Chris King

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Practicing and trainee (pre-service) teachers were asked to test four different interactive field strategies. The strategies use geological exposures and their surrounding environments to engage pupils in the examination and interpretation of geological processes. The four strategies, specifically developed for these purposes were: 'View from the site'; 'What was it like to be there?'; 'Interactive simulation' and the 'Prove it' approach. Feedback from the teachers indicates that the strategies are effective and have the potential to help pupils to develop deeper understanding of geological processes through interactive fieldwork.

It is hoped that there will be opportunities to demonstrate the strategies at appropriate sites during the field visits undertaken as part of the International Conference of the Outdoor Learning Environment.

Problem:

How can different strategies be used at the site of a geological exposure to 'bring the exposure to life' for school pupils, and to enable them to engage with the exposed strata?

Study Design:

Four different strategies were devised to enable geoscience educators to engage with geological exposures and to help their student to do so, too. Serving and pre-service geoscience teachers were asked to undertake the strategies on site and then to report back on their effectiveness as teaching tools. The four strategies are:

The **'View from the site'** strategy (most effective in areas of varied landscape) – participants are asked to describe the 'view from the site' and then to discuss how much they can tell about the local geology simply from the 'view from the site'. Prompting questions are as follows.

- Is it likely that the toughest rocks form the highest hills – if so, where are the most-resistant rocks in the region?
- Is it likely that the weakest rocks form the lowest areas – if so, where are the least-resistant rocks in the area?
- How can any landscape features visible be explained in terms of rock distribution and resistance?
- How have humans influenced the landscape?

The objective of this strategy is to help participants to situate exposures in their regional contexts, and to develop landscape interpretation skills and teaching methods as an introduction to the exposure to be studied.

The **'What was it like to be there?'** strategy (most effective where clear bedding planes or lava surfaces are visible in exposures) – participants are asked to describe what it might have been like to be standing on the bedding plane/lava surface as the deposit was being formed, with prompt questions such as the following.

- Was there water here, if so, how deep was it; would you have needed a snorkel, scuba gear or a bathysphere?
- Could you have stood up; was it muddy, sandy; how fast was the current; would you have burnt your feet?

- What would you have been able to see; what would the visibility have been like; would you have seen anything living; what colours might they have had; what other colours might be seen in the environment?
- What would you have heard?
- What would you have smelled in the air; tasted in the water?
- Would you have been happy; worried; scared?
- The objective is to help participants to gain a real 'feel' for depositional environment though the engagement of all their senses.

The **'Interactive simulation'** strategy – participants are asked how features they can see in the exposure might be modelled/ demonstrated practically on site. Then the equipment they suggest might be needed is revealed and the feature is modelled. Features that lend themselves to modelling on site include: the 'erosion' of shells or rocks in a plastic container by shaking; the formation of bedding planes by settling in water in a test tube; the formation of lamination by settling clay in a jar with and without salt in the water; graded bedding in a jar, formed by both settling and a slowing water current; formation of cross bedding in air in a jar; formation of cross bedding in water using a long container of sand; asymmetrical and symmetrical ripple formation in a circular container; a density current using milk in a small tank; controls on the viscosity of magma, using treacle; 'dyke'-formation in a jelly 'volcano'; and a rising warm current of dyed water through a hole in a rock, simulating hydrothermal mineralisation.

The demonstration of models in front of the features they formed, provides the opportunity for detailed discussion of the processes involved and of the effectiveness of the models.

The **'Prove it'** strategy (most effective with experienced geoscientists, and so less appropriate for school pupils). Participants are asked to observe an exposure and are given the professional description and interpretation of the exposure. They are then invited to discuss and feed back on questions like the following.

- Was there water present, if so, of what depth?
- Was the environment turbulent or quiet?
- What might the visibility have been?
- Was the environment suitable for life; what were the levels of food, sunlight, oxygen?
- What was the salinity of the environment?

As they discuss and report back on these issues, their responses are recorded. Finally a record of their responses is read back to them and they are asked to 'Prove it' by reference to features on the site.

This strategy demonstrates how difficult it can often be to provide strong evidence for water depth, salinity, energy-levels, etc. and so the strategy frequently tests the pre-conceptions of the participants.

Findings:

Participants were invited to provide feedback on the second, third and fourth strategies, and a preliminary analysis of the results is as follows:

Discussion:

The results indicate that most participants found the strategies to be valuable. There was most enthusiasm for the 'Interactive simulation' strategy with comments such as, 'Raises lots and lots of discussion' (practicing teacher - PT) and 'Excellent for actually visualising processes which form the features in the rocks' (trainee teacher - TT). The 'What was it like to be there' strategy provoked comments such as, 'Completely novel and provocative. It asked questions I'd not considered' (PT) and, 'This is a great 'story' re-enactment of an environment.' (TT). The 'prove it' approach proved to be more challenging, but nevertheless provoked positive comments, such as, 'Get 'em to work it out for themselves! They'll remember it better than if I tell them.' (PT) and '…it makes you question your knowledge with so many debates going on.' (TT).

Conclusion: Feedback on the strategies has shown that both practicing and trainee (pre-service) teachers found them to be effective and thought-provoking to different levels, with this summary from a trainee teacher, 'Didn't quite realise the multitude of things you could accomplish on a visit. Learned loads of new approaches'.

It is hoped that there will be opportunities to demonstrate these strategies at appropriate sites during the field visits undertaken as part of the International Conference of the Outdoor Learning Environment.

Strategy	Participants	No. responses	Mean 'enthusiasm' for strategy on 1 (v. positive) to 3 (neutral) to 4 (negative) scale	Percentage which considers the approach 'causes reflection'
'What was it like to be there?'	Practicing teacher responses	15	2.1	66
	Trainee teacher responses	32	2.1	38
'Interactive simulation'	Practicing teacher responses	5	1.6	40
	Trainee teacher responses	31	1.7	26
'Prove it'	Practicing teacher responses	5	2.2	100
	Trainee teacher responses	31	2.8	58

Environmental Education Fieldtrip on the left bank of the river Minho (Portugal)

Helena Esteves[1], Clara Vasconcelos[1], I. Fernandes[1] and Domingos Rodrigues[2]

[1]University of Porto and CGUP, Portugal

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An Environmental Education Fieldtrip has been carried out on River Minho's left bank, organized in accordance with Orion's model (1993). Five study stations were included in the Fieldtrip, providing a didactic approach to anthropic interventions and their environmental, economic and social impact. The vast local geodiversity was also observed and its geological aspects taught to students. Didactical materials were elaborated and evaluation instruments were applied during the three stages of the Fieldtrip activities: preparatory unit, Fieldtrip and summary unit (Orion, 1993). A mixed method research was applied, where different types of data were collected and the multiple methods used were triangulated. The analysis of the results indicates that the Fieldtrip was effective in facilitating the development of conceptual knowledge, motivation and competences among the participating science students.

Subject:

As a consequence of the intense anthropic intervention on Earth, the implementation of Sustainable Development strategies is a pressing issue, and the role of Environmental Education (EE) in this is crucial, where EE can be optimised through the Teaching of Geology. In its approach to Secondary Education the Portuguese Ministry of Education outlines the need to form environmentally literate citizens and develop in them sustainability competences (Esteves, 2011). This basis supports the problem underlying the present research – the need to teach the Geology of a region near the left bank of river Minho (figure 1), in order to develop competences which are crucial to EE. Several authors argue that Geology Fieldtrips (FTs) contribute positively to EE, namely Hopkinson et al. (2008). In this sense, a set of FT activities were used in order to achieve the structural objectives of the research: (i) to educate for the environment, by developing citizenship competences, geological knowledge and an appreciation for the conservation of geodiversity; (ii) to motivate the learning of geology and of environmental issues; (iii) to build didactic materials and apply strategies for the learning of geology and the internalization of environmental ethics; (iv) to assess the efficiency of the FT carried out in accordance with the Orion's organizational model (1993).

Study design:

The study had the participation of 115 Secondary School Geology students (mean age of 16.4 years), from the 11th grade of a public school in a predominantly rural region (Monção, Portugal), distributed into five classes (2009 and 2010), each class having carried out the activities independently of each other. After inventorying the didactic potential of the left (Portuguese) margin of River Minho (Monção), some possible itineraries were outlined, considering the curricular implementation of the thematic issues of anthropic occupation and territorial planning problems, and land geological processes and materials.

The FT activities were planned and implemented, in accordance with Orion's organizational model (1993), in three stages: Preparatory Unit, Fieldtrip and Summary Unit. By relating curricular concepts to field resources, in the area surrounding the school, specific teaching materials were created. In the first stage, set in the classroom (135 minutes), the novelty space was reduced (Orion, 1993), promoting motivation, and preparing activities, through the formulation of problem-questions and the use of informative work sheets and Powerpoint multimedia presentations. The Fieldtrip tasks (1 day) were carried out in groups of 5/6 students, based on a Field Guide and on mini-posters, following a five-study station itinerary (figure 2). The final stage was carried out within the classroom (135 minutes) and allowed reflection, consolidation and evaluation of the activities, using worksheets, Powerpoint presentations and an evaluation test. The teacher, also the researcher, acted as a catalyst, encouraging the students to carry out their own research when trying to solve problems, and also to debate their ideas with each other. During the various stages, an observer of moderate involvement – a Geology teacher from the same school level – was present for the evaluation. At each stage, several data collection instruments were applied: an evaluation test, oriented classroom reports from the researcher and observer, and snapshots of students with items for closed and open ended answers. Moreover, the adaptation of the SOLEI Inventory (Orion et al., 1997) for the Portuguese population was then implemented, which encompassed 62 items distributed by seven subscales, with respective Cronbach's alpha values as follows: (A) environment interaction – 0.65 (7 items); (B) integration of fieldtrip and regular classes – 0.71 (10 items); (C) student cohesiveness – 0.69 (9 items); (D) teacher support – 0.77 (10 items); (E) open-endedness – 0.60 (7 items); (F) preparation and organization of the fieldtrip – 0.70 (10 items); and (G) material environment – 0.69 (9 items).

Findings and discussion:

Over the five study stations of the FT (figure 3), students carried out tasks related to curricular content: rock types; classification of granites (colour, texture and mineralogy); faults and discontinuities; rock weathering; differential erosion and forms of erosion (giant pots and other); waterway transport and deposition; classification of sediments (size and shape); river dynamics; aquifers; thermal waters; flood and summer plain; the transverse and longitudinal profile of the river; the shape of the valley; the effects of the extraction of aggregates and of the construction of dams; evidence of anthropic intervention (fisheries and other) and of natural hazards (land movement and floods).

After the completion of the whole implementation process, the analysis and triangulation of the results obtained was carried out with the different evaluation instruments available. In the evaluation tests, 75.5% of students reached ratings of over 10 values (scale from 0 to 20), where 68.2% were in the range from 10.1 to 16 values, with an average of 12.4 in 2009 and 11.3 in 2010. Thus, it was found that students developed the requisite competences in a satisfactory fashion (Esteves, 2011).

Figure 1 – General aspect of the River Minho's bank (Portugal), showing granite outcrops and the fisheries.

The results of the statistical analysis of data of the adaptation of the SOLEI scale for the Portuguese population showed that the subscales of higher average value were: (B), (D) and (F), whilst the lower value ones were (A) and (E). Considering the 5-point Likert scale for the answers, it was found that the average value for the items was always higher than 3.7 in all subscales. After categorizing the scores for students' answers (figure 4), it was found that they scored mainly in middle and upper-middle categories (73.4%) for subscale (E), whereas the rest of them scored preferentially in the upper-middle and upper categories (A – 67.0%; B – 77.01%; C – 74.3%; D – 78.0%; F – 76.2%; G – 78.0%). In general, the results were very positive and the adequacy of the FT planning was demonstrated (Esteves, 2011).

Through the application of statistics to the data from closed-ended answer items (3-point Likert scale) of snapshots (Preparatory and Summary Units), it was found that students, in general, displayed shortcomings in asking questions and/or in participating in the debate, but they also displayed an interested attitude in class and in the active performance of tasks, expressing their enjoyment towards the classes attended, as well as their agreement as to the clarity of all explanations given and the usefulness of the classes. The open-ended answers were subjected to content analysis, and it was found that students demonstrated a large number of facilities and positive aspects in the categories of work development and learning of Geology contents, rather than difficulties and negative aspects (learning and motivation for some students, within the classroom and adverse weather conditions). Students listed many issues they grasped and a few which they would have liked to have understood better, besides having valued the mediation of the teacher within the classroom environment, as well as the motivation in the field (Esteves, 2011).

The observers and the teacher pointed out difficulties and facilities in mediation, depending on the classes and the weather conditions, and also how the difficulties impacted some student's development of work. Facilities of young people were confirmed in their learning and in the development of work, although, in some individual cases, these have also been difficulties. Students' motivation and learning were the main categories mentioned in the positive aspects, as they identified a huge number of motivation signs (87) and a small number of demotivation ones (20). The FT model was considered adequate, allowing timely and dynamic adjustments without changing the overall structure, in addition to the integration of theory and practice and the systematization of knowledge (Esteves, 2011).

Figure 2 – Groups and students in field activities at Barbeita (A) and confluence of Rio Mouro (C) and also a student measuring attitudes of discontinuities (B) and collecting rock samples (D).

Conclusion:

The evaluation of the efficiency of the Fieldtrip, carried out in line with Orion's (1993) organizational model, as a strategy for the Teaching of Geology in an EE framework, made clear the latter's advantages in educating for the environment, and for Sustainable Development. The results of this evaluation clearly demonstrated that the FT was not only an effective means of imparting knowledge to the students but also that it motivated them to learn about Geology and environmental issues. Thus, the students developed citizenship competences and an awareness of the need for the conservation of geodiversity in general, and that of the region surrounding the school in particular.

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- Hopkinson, P.; Hughes, P. & Layer, G. (2008). Sustainable graduates: linking formal, informal and

Figure 3 – General aspects of the five locations of the fieldtrip on the river Minho's bank (Monção, Portugal): (A) Alluvial deposit and fisheries (Santo Antão); (B) Traces of erosion and marks of the river bed (Valinha); (C) River morphology and granite outcrops with fisheries (Ponte do Mouro); (D) River curvature showing the erosion and deposition; (E) Alluvial deposit on the open valley and Monção village in the background (Caldas de Monção).

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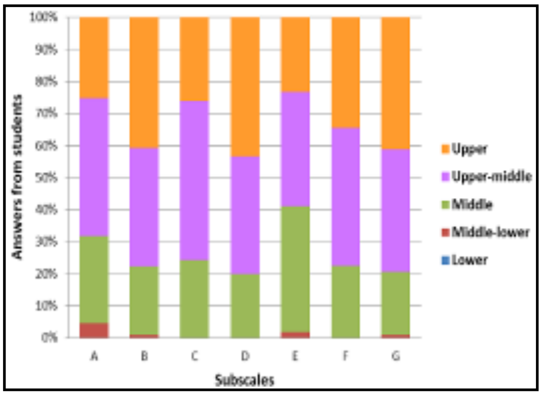


Figure 4 – Graph of the results obtained with the score of the answers from students in the several classes, for the five subscales of the evaluation inventory (adaptation of SOLEI).

Ideal to Real: the Transition from Perfect Settings to Imperfect Environments

Molly Yunker

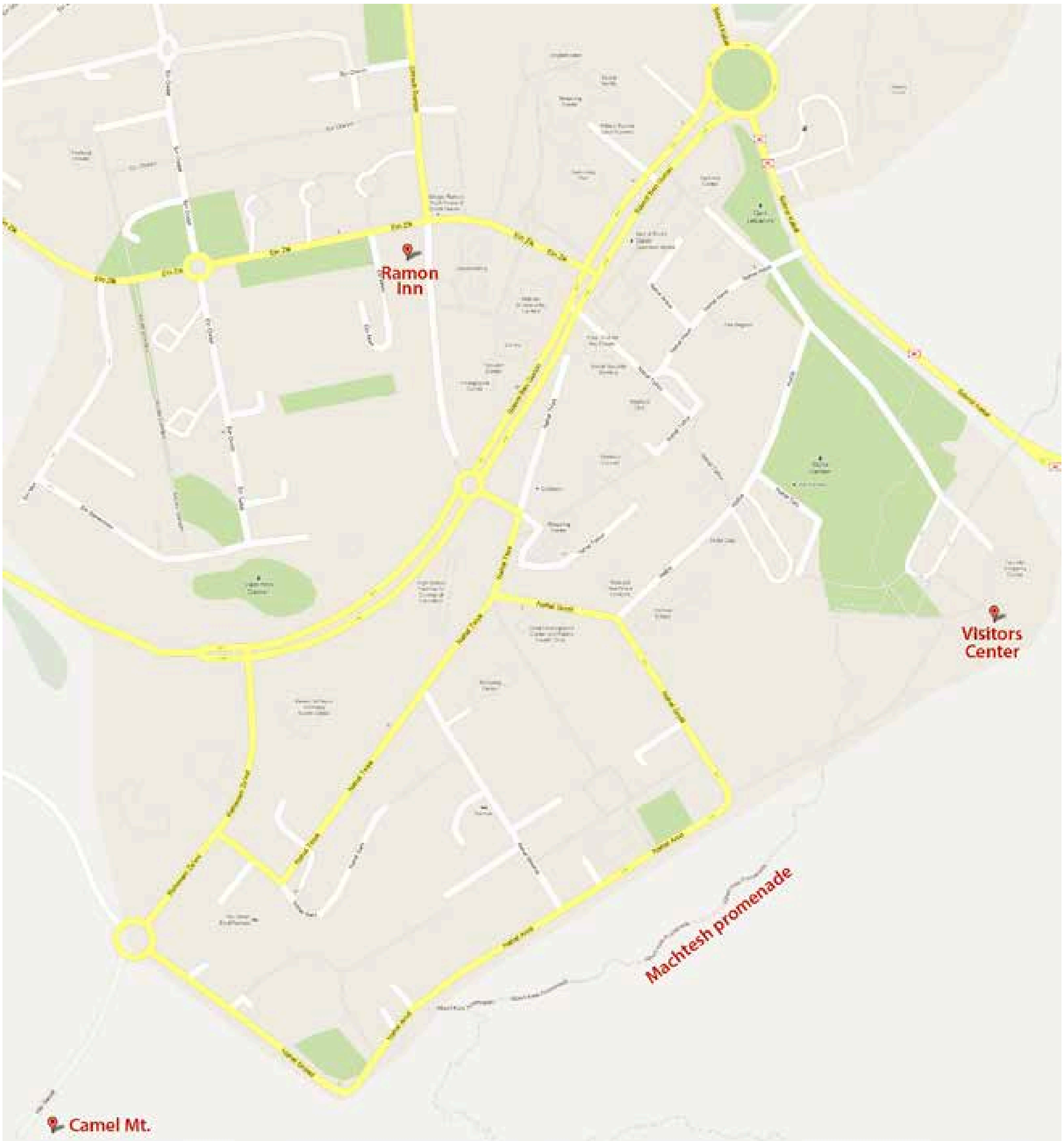
Cave of the Mounds, National Natural Landmark, Wisconsin (USA)

The journey from an ideal research context to a more realistic setting has been eye-opening, and can shed light on some of the challenges we must deal with as educational researchers, teachers, and learners.

There is no doubt that educational research on teaching and learning provides valuable insight into practice, but the nature of this research is often idealized to the point of being impractical or minimally relevant to an actual teaching and learning context. I will discuss three stages in the development of my awareness regarding the unique context of the outdoor learning environment:

1. My doctoral research was conducted in a science classroom, and followed the experiences of a single teacher engaging in the legitimate inclusion of outdoor learning experiences into an Earth Science curriculum with 120 middle school students. This stage represents the most ideal enactment of the use of the outdoors in the curriculum.
2. Stage 1 raised questions regarding the role of teachers in moving educational innovations forward in their own classrooms. This led to a project in which teachers were encouraged and offered support with the introduction of the outdoor learning environment into existing curricula. This tailored-to-your-needs-curriculum project highlighted the idea that new ventures are strongest if they come from within. This type of "professional change" rather than "professional development" cannot be forced from outside of oneself. Experiences during a workshop about the outdoor learning environment with teachers in Argentina further strengthened this idea.
3. My current position as the Educational Coordinator for a cave in Wisconsin has led to a multitude of experiences seeing school teachers' actions during field trips to our underground classroom. The tendency of teachers to hand over the reins entirely to cave staff suggests their desire for continued separation between the work they do in the classroom, and that which can be done outside of the classroom. Yet, one goal we have as researchers and educators is to better integrate indoor and outdoor experiences. In the real world and the practical context of the classroom, how can we encourage a greater synergy between these learning environments?

Mitzpe Ramon Map



Tuesday – February 5, 2013

07:00	*Breakfast*
08:00	Traveling to Eilat (Red Sea)
08:30	Short walk in the Machtesh (Carpentaria)
11:00	**Yotveta** (Malla Shahrut) school
11:45	Outdoor demonstration: **A zoo learning** environment (**Hai-bar**)
12:30	*Lunch break*
13:15	Outdoor demonstration: **Timna Park**
14:30	Arriving at the hotel (King Salomon) and getting settled
14:45	*Coffee break*
15:00	**Interactive session – Hotel** » **C. King:** Should there be progression in the teaching of geological fieldwork? » **P. Ferreira, C. Vasconcelos and D. Rodrigues:** Secondary school students' field trip in coastal zones of Vila do conde (Portugal) » **H. Ginat:** Outdoor study of High School Students' Research Projects as a Pedagogic Tool » **O. Popov and R. Engh:** Exploring pedagogical potential of outdoor context in teaching physics for prospective primary and secondary school teachers » **H. Esteves, C. Vasconcelos, I. Fernandes and D. Rodrigues:** Environmental Education Fieldtrip on the left bank of the river Minho (Portugal)
16:30	Free time for visiting the Red Sea beaches.
19:00	*Dinner*
20:00	**Plenary session** **Prof. Tali Tal:** Museums and nature: common issues in different learning environments

The Hai-bar Zoo Worksheet

Take 15 minutes for exploring the zoo.

A. Learning and teaching

- If you meet a group of students please write down your impression of their learning behavior:

1. What kind of interaction do the students have with the exhibition?
2. How many students (percent) are actively interacting with the exhibition?
3. What is the role of the local guide?
4. What is the role of the teacher of the group?
5. How were students prepared for the visit?
6. Try to ask students what they have learned here and how it relates to their school learning?

B. Exhibition

1. Select the curriculum and the age level with whom you would use this exhibit (next page).
2. Write in the table (next page) the concepts / skills that you would develop for the activity.
3. Describe the direct interaction with the exhibit that will lead to the construction of the concepts/skills?
4. How would you prepare the students for this visit?
5. How would you continue the activity in the classroom?

C. Strengths and weaknesses

1. Consider the zoo as a learning environment that is an integral part of the school curriculum.

   What are its strengths? ....

   ....

   ....

   ....

2. Consider the zoo as a learning environment that is an integral part of the school curriculum.

   What are its weaknesses? ....

   ....

   ....

   ....

Subject matter	Elementary school	Middle school	High school
Science for All	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Biology	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Art	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Mathematics	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Languages	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Environment	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Literature	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Religion	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....
Other:________	Concept/skill:........................	Concept/skill:........................	Concept/skill:........................ ....

Should there be progression in the teaching of geological fieldwork?

Chris King

Keele University, UK

A suggestion that there might be progression in geoscience fieldwork was tested by asking groups of experienced geoscience educators to carry out sorting exercises on geoscience fieldwork skills against a statement of the progression of investigative science skills provided by the English National Curriculum for Science. The first attempt at this showed that the educators felt there was progression, but couldn't decide on what this progression actually was. Thus a second sorting exercise, based on eight different areas of geoscience fieldwork skills, was undertaken by 30 geoscience educators working largely in groups of three.

The results from this exercise indicated that there is a perception of progression in geoscience field skills, but that this is stronger in some areas than others. Nevertheless, the data allowed the skills in each of the eight areas analysed to be put in order of progression. An example is included of the progression in the area in which agreement was strongest, the use of field equipment.

This work on progression suggests that there is a sequence in which field skills should be taught, from the most simple to the most abstract. This may assist geoscience educators in the future teaching of fieldwork skills.

Subject:

It is possible that a pupil in the UK could be undertake 'pond dipping' (collecting and identifying creatures from a pond) five times during their school lives (as infants, 5-7 year olds; as juniors, 7-11 year olds; as lower secondary pupils, 11-14 year olds; as upper secondary pupils, 14-16 year olds; and as post-16 students, 16-18 year olds), which has provoked amongst biology teachers the thought that there should be progression in this type of fieldwork. This has provoked a similar question for geology – 'Should there be progression in the teaching of geological fieldwork; if so, what should this progression be?'

Study Design:

The current National Curriculum for Science in England allocates different levels of difficulty to the approach and content of the science curriculum, allowing pupils to be 'levelled' against different parts of the curriculum. This applies to the 'How science works' part of the curriculum with encompasses investigative science. A sorting exercise was devised by allocating a range of fieldwork skills to the levelled investigative science curriculum and cutting up the result. The exercise was tested by groups of practicing science teachers at an Earth Science Teachers' Association (ESTA) day-long workshop. The result of this sorting exercise was that everybody agreed that there was a progression in geoscience fieldwork skills but there was little agreement on what this progression actually was. A particular problem was that several fieldwork skills had been allocated to each level, and those present thought that some of the skills allocated to each level should have been allocated differently.

On the basis of this, this first attempt was regarded as a pilot exercise, and a new sorting exercise was devised. This divided fieldwork skills into eight fieldwork areas, as follows:

- Use field equipment accurately
- Use a topographic map effectively
- Map geological boundaries properly
- Identify rocks/ minerals correctly

- Identify exposed structures correctly
- Identify landform features correctly
- Record field information effectively
- Collect and use geological information effectively

Statements of the different skills in each of these areas were listed progressively, from the simple to the more complex. This order was then tested in a second sorting exercise, where practicing teachers and geoscience educators at ESTA and Earth Science Education Unit (ESEU) meetings, working together in groups of three, were asked to sort out the statements in order of difficulty and then to allocate each of the statements to levels in the 'How science works' curriculum. They were then asked to comment on whether they felt there was progression in this particular element of fieldwork, using a Likert scale from 1 (progression obvious) to 5 (none found).

Findings:

Preliminary results, from ten groups, usually of three individuals, comprising a total of 30 individuals, is given below.

For each of the fieldwork areas, the mean level of each statement was calculated, and the standard deviation was also calculated. Even though the data were sparse, the standard deviation gave some perspective on the consistency of the views. The standard deviation data was averaged for each area of fieldwork to give a second perspective on the strength of the progression found. The results are presented in the table below:

Area of fieldwork	Mean questionnaire response to the question: 'Is there a progression in this element of Earth science fieldwork?		Mean standard deviation of attempts to allocate statements to NCS levels	
	Likert scale mean	Word summary	Mean SD	Word summary
Use field equipment accurately	2.4	There is some progression	1.16	Good agreement indicating good progression
Use a topographic map effectively	2.7	There is little progression	1.14	Good agreement indicating good progression
Map geological boundaries properly	2.5	There is some progression	1.29	Fair agreement indicating fair progression
Identify rocks/ minerals correctly	2.0	There is good progression	1.52	Poor agreement indicating poor progression
Identify exposed structures correctly	2.4	There is some progression	1.57	Poor agreement indicating poor progression
Identify landform features correctly	2.7	There is little progression	1.60	Poor agreement indicating poor progression
Record field information effectively	1.5	There is very good progression	1.67	Poor agreement indicating poor progression
Collect and use geological information effectively	2.4	There is some progression	1.35	Fair agreement indicating fair progression

The data indicate that there is some perceived progression in geoscience fieldwork, although this perception is stronger for some areas than others, whilst the two different measures of perceived progression sometimes give results that correlate well and sometimes do not. Nevertheless, a perception of progression was noted for all areas of fieldwork, with the strongest perception being for the use of field equipment.

The levels allocated to the different statements in each area can be used to give the best agreement of progression for each area of fieldwork. The results are most significant where agreement is strongest, as for the use of field equipment. The results for this area are given below as an example.

Use field equipment accurately	**Mean NCS level**	**Standard deviation**
Statement	**allocated**	**of ten group views**
Use a magnifier	1.6	0.69
Use a tape measure/ruler	2.4	0.82
Use tools to measure hardness	2.8	0.89
Use a size comparator	2.8	1.17
Use a handlens	3.1	1.20
Use acid test	3.3	1.33
Use a geological hammer safely	4.6	1.53
Use a compass to take a bearing	5.6	1.21
Estimate size	5.8	1.58
Use a clinometer to measure dip	5.8	1.17
Estimate distance	6.0	1.14
Use a compass to measure dip direction/strike	6.7	0.98
Estimate dip and dip direction	7.3	1.33
	Mean standard deviation	1.16

Discussion:

A preliminary analysis of the data from the fieldwork progression sorting exercise indicates that there is progression in difficulty of geoscience fieldwork skills and that this is stronger for some areas of fieldwork than others. The strongest perception of progression was found in the area of the use of fieldwork equipment and the progression identified is given in the table above.

Conclusion:

The sorting exercise carried out by experienced geoscience educators on statements of fieldwork skills in eight areas of geoscience fieldwork has indicated that there is progression in these areas, but the perception of progression is stronger in some areas than others. The data can be sorted to show what this progression actually is, according to these perceptions, and an example is provided for the 'Use field equipment accurately' area.

This work suggests that fieldwork skills should be taught in a certain order, from the simplest to the most abstract – and also suggest what this order might be. These findings should assist educators in the future teaching of geoscience field skills.

Secondary school students' field trip in coastal zones of Vila do Conde (Portugal)

P. Ferreira[1], Clara Vasconcelos[1] and Domingos Rodrigues[2]

[1]University of Porto and CGUP, Portugal

[2]University of Madeira and CGUP

The use of field trips as outdoor learning environments is not sufficiently emphasised in the curricula of Secondary Schools in Portugal. Due to the difficulty in organising field trips and in evaluating learning outcomes teachers are reluctant to use them as a teaching strategy. The present study presents some activities carried out in order to organise a field trip with students of the secondary school subject of "Biology and Geology", from a school in the north of Portugal. The authors highlight the importance of didactic materials and instruments in evaluate learning outcomes during these educational activities. The relevance to the success of the field trips in coastal zones of Portugal, of defining study stations and elaborating posters and field guides is also emphasized. The field trip was organized according to Orion's model which facilitated its construction, implementation and evaluation.

Subject: As field trips are not generally part of the educational strategy of Portuguese schools, the present study discusses the value of these activities as educational strategies. When these are integrated into a school's curriculum, and supported by various didactic materials which enable the development of competences, they ease the understanding of processes, phenomena and geological structures.

Development of the study:

Approximately 30 km north of the city of Oporto (Portugal) the coastal zone of Vila do Conde, more specifically its beaches, is characterized by large and well exposed outcrops of metamorphic and magmatic rocks, figure 1. This area constitutes a privileged place for field trips and fieldwork activities, not only because it is near several schools, but also because these beaches allow rocks, lithological units and geological structures, resulting from internal geodynamical processes, to be directly identified, described, measured, sampled and mapped. The former processes cannot be observed or tested in laboratory experiments (Ferreira, 2011), and the latter activities allow the students to make analyses and interpretations. The collected information is organized afterwards, in the summary unit.

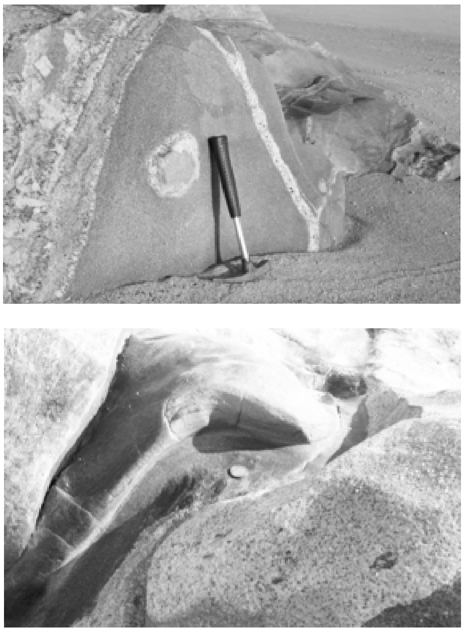


Figure 1: Geological aspects of the area.

A geological itinerary was set, on the basis of a previous geological investigation, which made possible the elaboration of a field guide in support of the field trip. This was done in three stages, according to the model proposed by Orion (Orion, 1993). Six field trips were made, with eight classes from the eleventh grade classes (students with an average age of sixteen), figure 2, from two secondary schools in Vila do Conde, totalizing one hundred seventy one "Biology and Geology" students. The teachers in charge of these classes received sixteen hours of training prior to the field trips which covered the fundamental aspects of

Orion's field trip model, the didactic materials developed for those trips, and the different activities available to them and their students during the various phases of each field trip. Also as part of their training, the teachers followed the geological itinerary, in situ, as presented in the field guide (Ferreira, 2011).

An evaluation scale of field science learning was created in order to evaluate each field trip, by adapting the SOLEI (Orion ***et al.***, 1997) to the Portuguese student population. This inventory is divided into seven subscales, all presented in table 1 with their respective number of items and Cronback alpha values.


Figure 2: Students during the field trip

Table 1 - Results of the validation of Portuguese version of the SOLEI

	Subscale A	Subscale B	Subscale C	Subscale D	Subscale E	Subscale F	Subscale G
Nº of items	7	10	9	10	7	10	9
α from Cronback	0.65	0.71	0.69	0.77	0.60	0.70	0.69

Tuesday

Other evaluation tools were used, figure 3, which allowed conclusions to be drawn as to the students' expectations and opinions of their field trip.

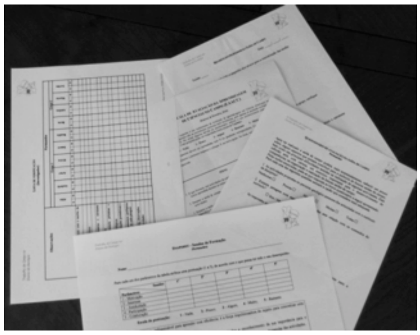


Figure 3: Portuguese version of SOLEI and another evaluation instruments used

Work done with the students:

Each class had at least two preparation lessons (preparatory unit) during which they got acquainted with the itinerary that they would follow, the lithological units and geological structures to be found on each stop of the itinerary, and the activities that they would carry out, following the field guide. Furthermore, they were trained in the measurement of the strike direction, dip magnitude and dip direction of layers using a compass-clinometer, as well as in the determination of topographic coordinates, and the reading and interpretation of geological and topographic maps of the region where the field trip was to take place, figure 4. All these preparation unit activities were carried out with the intention of reducing the novelty space, as described by Orion's model (Orion, 1993). Each field trip lasted about eight consecutive hours, with one-hour break for lunch, and followed the six study station geological itinerary aid out in the field guide which comprised of six stops. A questionnaire was administered at each stop, covering the different observations and tasks to be carried out.


Figure 4: Students during preparation unit activities

Four of the six study stations on the geological itinerary were specifically focused on the development of geological competences such as the measurement of layer direction, the identification of geometric elements of folders and the macroscopic identification of minerals. The two remaining study stations covered environmental and socioeconomic issues such as the importance of the exploration of mineral resources, its environmental impact and the use of those resources in different areas of human activity. Two lessons in the summary unit were given after the field trip, in accordance with Orions's model (1993). Simple summary unit questionnaires were administered to assess how effectively, if at all, the field trip increased their motivation, interest and willingness to learn Geology. Finally, the field guide exercises were corrected and all questions raised by the students were answered.

Discussion:

The field guide was the most useful of all didactic materials created in support of the field trip, allowing the students to manage their progression through the different activities planned for them, and directing their attention to the relevant phenomena to be observed. The vast majority of students displayed curiosity, enthusiasm and were collaboratively engaged in the various activities available at the different stages of each field trip.

Conclusion:

The students were able to explain content presented to them in lessons after the field trip, by drawing comparisons to the related phenomena observed in the field. This demonstrates the development the students' conceptual competences reinforcing the importance of field trips and fieldwork in teaching and learning Geology.

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Outdoor study of High School Students' Research Projects as a Pedagogic Tool

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Earth Science teaching at all levels encourages using multi-learning environments. Special emphasis in the Israeli curricula is given to outdoor learning as a central environment integrated with the other learning environments. This approach provides direct experience with phenomena and material to improve the student's skill. In addition to studying a conventional core curriculum in Earth Sciences, the independent learner conducts several projects that affect the dynamic advance in the curriculum. Most of these projects are connected to field trips and laboratory work, combining indoor and outdoor learning. The outdoor learning leads the students to find and analyze phenomena and do professional work in the field. The highest level assignment of outdoor studying is an independent research project. This is a dynamic project in which students have to deal with in-depth study of a selected subject combining observations from different sources. The students become deeply involved in research and therefore the learning process becomes very significant, meaningful and positive. By preparing this project, students achieve high level thinking skills of integration and discussion.

Subject:

Earth Science teaching at all levels encourages using multi-learning environments - classroom, lab, computer, media and outdoors. In addition to studying a conventional core curriculum in Earth Sciences, the independent learner conducts several projects that affect the dynamic advance in the curriculum Successful execution of the stages of the curriculum may lead students to take part in the highest level assignment – the Independent Research Project (IRP). The highest level of Earth Sciences is achieved by the students' Independent Research Project (IRP), which has proved to be a pedagogic tool with major impact on learning and teaching. The students who conduct an IRP use the outdoor study as their main learning environment.

Students in Ma'aleh Shacharut High School (rural high school in the Southern Arava) write Independent Research Projects (IRP) as the final part of their earth sciences studies. The project is done on a wide variety of topics in geology, geomorphology, hydrology and environmental education. The main part of each research is done in the field and many projects use laboratories to analyze their findings.

The IRP is a dynamic project in which the student has to deal with scientific material. Each student should pass all the main stages that are needed for real research: planning, focusing, and collecting data from different environments (as lab and field experiments), reading relevant bibliography, collating, writing, preparing figures, editing, presenting and publishing. This project is done during 12 months in the last two years of school and the assessment is given by an academic expert. The IRP becomes the most meaningful and enjoyable learning in school. Therefore it will be remembered by the student as the main positive, challenging and significant experience from school.

The following are some examples of projects conducted over the last years by Ma'aleh Shacharut students: "Changes in the sea surface of the Gulf of Elat upon global climate (?) changes", "Geological aspects of extreme events in the Biblical stories", "Climate change in Southern Arava over the last 60 years", "Limestone concretions in the Southern Negev", "The environmental aspects of renewable energy in the Arava" and "Retreat and advancement of glaciers during the last years in New Zealand and Norway".

Each one of the research projects is based on field work. Students work independently in the field for 8-15 days, collecting data and drawingcross sections and maps. This outdoor study has several logistic problems that need to be solved. Part of these problems, such as not going alone to the field, are solved by the students when they ask their friends or parent to join them. The supervisors also join the students in the field after they have done some steps by themselves. Not all students can complete the full investigative process and succeed in carrying out their IRP. Those who succeed have climbed to the top of the "Learning Pyramid," and for them the independent learning becomes a powerful strategy. These IRP projects are also part of the curriculum in biology, social studies and many other subjects. In each one of the disciplines field work is a needed condition for the projects.

The IRP is supervised by a post-graduate teacher. Each one of the teachers who takes part in this becomes a partner in the research, and by this improves his/her research skills. Teaching thus becomes more interesting and enjoyable also for teachers. One can also use figures and texts that were prepared during the project. Working together on the IRP also helps to develop good personal relations between the student and his/her teacher.

In some cases the teacher can continue, widen and deepen the project, and it can become an advanced scientific study. For example in the IRP: "Development of the Eilat Gulf" the Plio-Pleistocene rocks were mapped, and this map was delivered to the Israel Geological Survey. The IRP "Geological and pedagogic aspects of the Israel National Trail" was the first milestone to the successful initiative: "Developing field guides for independent hikers along the Israel National Trail". The next stage of this project was developing a cellular tour guide in southern Israel. The users can receive data on their cellular phones in the field that was prepared by the students as part of their Independent Project.

The development of investigation literacy in the context of science consists of several sequential stages arranged in a hierarchical pyramid structure. The Independent Research Project becomes the highest level of learning. Outdoor study is important and meaningful part of these projects.

Exploring pedagogical potential of outdoor context in teaching physics for prospective primary and secondary school teachers

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This paper presents a conceptualisation of over ten years practical experience of working with "outdoor component" in science teacher education in Umea (Sweden). The Activity Theory (AT) has been used to provide theoretical ground for reflection on educational work and students' activities in the outdoor context. Our experience of exploring pedagogical potential of outdoor context in teaching physics for prospective primary and secondary school teachers is also illustrated by concrete examples from different courses and student examination papers. Evidence provided by this study and students research shows great potential of outdoor learning environment but also reveals issues related to motivators and pedagogical complexity of outdoor teaching demanding purposeful development of teacher competence and great deal of private interest.

Subject / Problem

There is obvious need of preparing future science teachers to work in post-modern society which is characterised by great uncertainties and complexities. According to our experience, outdoor context has powerful potential to serve as an exploratory learning environment where inquiry about authentic, complex and uncertain tasks can be naturally implemented. Therefore, we assume that teachers need to be purposefully taught to work with uncertainties and complexities when doing inquiry in outdoor context. This process demands systematic efforts from the teacher educators (Dillon, 2010).

Currently, in Sweden and internationally, there is a visible growing interest in outdoor education. Slingsby (2006) expresses his conviction that "the future of school science lies outdoors". Research shows that a variety of natural settings can be used effectively for students' science investigations outdoors such as schoolyards, playgrounds, gardens, zoos, and amusement parks (Braund, Reiss, 2006, Nilsson, Pendrill, Pettersson, 2006). However, most of the pedagogical activities outdoors are focused on social competence development, or study of nature from biological and ecological perspectives, but physics teaching remains largely indoors bound.

Vygotsky (1978) considered context as an active component of the learning process that interplays with learner's and teacher's activities. Following this line of thought, we suggest that partly placing the study of laws and properties of nature (physics) directly in natural settings and in the context of active social interactions between students and teachers, will make important contribution to building up prospective teachers' pedagogical competence in science teaching.

Working in the field of science teacher education in Sweden, we have experienced that students of both sexes are interested in outdoor activities. During the last ten years more than half of the more than 30 students, who studied outdoor teaching in the examination papers of teacher education at Umeå University, were female students. Free-choice outdoor courses have higher enrolment of female students as well. However, we have seen a need for purposeful development of teacher competence in outdoor physics as this is not a common part of school science education.

Study design

At our department, prospective teachers work with physics activities outdoors in different forms and on different occasions, such as outdoor education courses, assignments in didactics of physics, school practice, summer and masters courses. The various aspects of outdoor science were part of teacher students' research projects presented at the end of their undergraduate studies. This study is mainly based on systematic reflection about our own experience of teaching outdoors courses and analysis of students' research projects, course work and evaluations of such courses. Prospective science teachers have been active agents of this study. They developed specific outdoor physics tasks, tested these both by themselves and with pupils in schools and evaluated their outcomes. In this paper, we attempt to provide analysis of outdoor physics teaching at our department using Activity Theory (AT) perspective.

Findings

In this section we present what can be considered as 'added value' of outdoor physics extracted from our practical experience with help of Activity Theory perspective. Pictures in the text below illustrate outdoor physics activities done by our students in different courses.

Practical collaborative activity facilitates physics learning
Naturally, practical activities outdoors have joint-collective enactment. This means that group or team activity has been the basic form of activity in outdoor physics. According to Leont'ev (1981), the first and most fundamental form of human activity is external, practical collaborative activity. Davydov (1996) claims that thought is an idealisation of the basic aspect of practical activity involving objects, and of the reproduction in that activity of the universal forms of things, their measures, and their laws. Thus, doing and learning interplay naturally in outdoor context.

Fig. 1. Exploring composition of forces and balance.

Physical and cognitive mediation as facilitators of learning
The fundamental claim of AT is that human activity (on both the interpsychological and the intrapsychological plane) can be understood only if we take into consideration technical and psychological tools that mediate this activity (mediating artefacts). To achieve an understanding of scientific concepts, laws and theories, students need to be actively involved in thinking, which requires the use of different mediating cultural tools. Learning depends on cultural artefacts mediating this activity (Norman, 1994). In outdoor physics, investigation techniques or processes of science (also called process-skills or skills of scientific inquiry: observing, measuring, classifying, hypothesizing, etc.) are artefacts that have particular significance. These mental and manipulative skills serve as important tools in the culture of science. In outdoor physics, large-scale physical artefacts like cable drums, cars, poles, barrels, etc. were also used as tools for stimulating learning (Popov, 2006).

Fig. 2-3. Exploring principles of mechanics in the playground

Physics as target object of outdoor activity

According to Leont'ev (1981), activities are object-related. The content of human activity is determined first of all by its object. The object of activity is always a value-loaded social object, i.e. a human-nature or human-technology system. When doing outdoor physics, the object of students' activities are natural or human made objects with their properties reflected in scientific principles, laws and theories of physics. Thus, the content (object) of learning is the acquisition of knowledge (embodied in learning objects) about properties and laws of nature. For example, when making a construction and studying different parameters of a hot-air balloon, the content of learning is about understanding density, heat transfer and Archimedes law.

Fig. 4. Exploring syphon principle.

Fig. 5. Using the Sun and optics for fire-making.

The dynamic nature of complex learning activity outdoors

AT is based on an understanding of activity as a constantly developing complex process. Leont'ev often referred to constant transfers within the system "subject (learner) – activity – object" (Stetsenko, 2005). AT emphasises dynamic relations and constant transformations between external (physical) and internal (mental) activities that constitute the basis of cognitive development.

Fig 6. Lifting student teacher's car (school practice).

Fig. 7. Exploring the power of levers.

In outdoor physics, experience with cognitive and physical tools, instruments and artefacts (like building a water rocket and exploring its properties, doing observations and measurements with the help of binoculars or a telescope) are valuable for the development of the learner's scientific worldview and his or her skills in and attitudes towards science.

The object transformations, along with learners' new knowledge, capabilities, mental and bodily presuppositions which they acquired in this process, are the expected outcomes of the learning activity. As mentioned before, in outdoor physics activities, learning objects are real material objects in the surrounding environment with their properties reflected in scientific principles, laws, and theories of physics. The learner performs actions on the learning objects, transforming the objects in intellectual and/or practical ways and changing him or herself in that process. Thus, prospective teachers develop necessary professional competences.

Openness and complexity of outdoor physics tasks forms student-teacher collaboration
When students work with experimental problems outdoors, expected results can be quite unexpected. There is a need for more heuristic rather than algorithmic ways of approaching the problem.

Fig 7. Making hot-air balloon fly.

Fig. 8. Exploring optics/reflections.

Errors have to be seen as new opportunities and challenges for learning rather than failure. The complexity of the real world situations demands the lecturer to be more researcher and partner for students in this work rather than possessor of the right answers. This situation, when the lecturer had to think together with a student about authentic problems is not what prospective teachers normally experience in teacher education. Accumulated experience and know-how acquired by prospective teachers in an outdoor physics can lead, hopefully, to similar educational activities in their future teaching.

Conclusions

The natural environment provides genuine opportunities for meaningful learning based on combination of minds-on and hands-on activities, but also requires additional preparation and carefully designed pre- and post-field work to make outdoor learning productive. Our experience and theoretical reflections show that outdoor physics activities can lead to real empowerment of prospective science teachers, giving them more control over and understanding of the science learning processes. They gain confidence of using new mediating artefacts of learning and have more open-minded approach meeting new objects of the study.

Fig. 9. Exploring torque.

Fig. 10. Working with friction and tension.

We argue that outdoor physics can be an effective and important complement to classroom-based physics learning. Such an approach seems to create new learning opportunities for different categories of students, from the bright ones to those with special needs, male and female, native and immigrants. We agree with Justin Dillon (2010) who argues for the value of science beyond the classroom. He wrote "Done well, field-work works. It improves knowledge; it improves skills; it improves motivation. Denying students fieldwork is like denying them books, or pens, or computers." (Dillon, 2010, p. 144).

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Wednesday, February 6, 2013

07:00	*Breakfast*
08:00	Traveling to the **Dead Sea**
11:00	**Outdoor demonstration:** concrete experiences with abstract concepts (Haimar Gorge).
12:30	**Outdoor demonstration:** Dead Sea industry
13:15	*Lunch*
14:30	Arriving at the hotel (Rimonim) and getting settled
14:45	*Coffee break*
15:00	**Interactive session – Hotel** » **K. Feille:** Three teachers' stories of using the schoolyard as an integrated tool for elementary teaching. » **T. Neal, and J. Gorsh:** Elementary Science Methods through School of the Wild and Ropes Courses » **A. Lindau, A. Finger and M. Lindner:** How do pre-service teachers see their competence in organizing field trips? » **W. Frazier and R. Fox:** Professional Development in STEM and World Language Via Problem-Based Learning To Support an Environmentally Responsible, Global Citizenry: Far East Russia and the United States » **A. Marcus:** Green school's outdoor learning environments as means of promoting environmental identity
16:30	Free time for experiencing the Dead Sea
19:00	*Dinner*
20:00	**Plenary session** Prof. Nir Orion: The contribution of the outdoor learning environment for the development of high order thinking skills.

Worksheet: Rocks and Energy in Haimar creek

A. The black rock

1. Please approach the rock exposure and identify its characteristics: ....

....

2. What kind of energy transformations are expressed by this rock? ....

....

3. What is the primary source of energy for the process you have identified above? Please explain:

....

4. How can man exploit the energy that is trapped in the asphalt? ....

....

5. How could this exploitation affect the earth systems? ....

....

B. Rocks' movement

1. Carefully observe the bedrock, which Haimar creek went through. To which group of rocks do they belong (Igneous, Sedimentary, Metamorphic)? Please explain: ....

....

2. Look carefully at the northern bank and try to identify a phenomenon that might indicate that the rocks here are not located in their initial position. Describe this phenomenon with a schematic drawing.

3. What kind of energy transformations are expressed by this phenomenon?..
....
4. What is the primary source of energy for the process that you have identified above? Please explain:...
....
5. How could man be influenced by the above energy cycles?..
....

C. Pebbles

1. Look at the pebbles that are sitting on the canyon bottom. Please write down all the energy cycles that occurred during the process of making the pebbles: ....
....
2. What is the primary source(s) of energy for the process that you have identified above? Please explain:...
....
3. What are the materials that were transformed during the energy transformations? ....
....
4. How could man exploit the above energy cycles?...
....

*Please don't forget to **collect rocks** samples and to **take pictures** for the **final report.***

Remarks and comments

....
....
....
....
....
....
....
....
....
....

Stop 4: Secondary evaporation pool

What crystallizes next?

1. Go to the edge of the pool and sample the water with the sampling stick. Please use your equipment (thermometer, hydrometer) and fill out the second row of the table below.
2. Sample the white substance which sank to the edge of the pool.
   - Do you think that the mineral which crystallized here is the same as the mineral you identified in the northern pool? Explain: ....

   ....

   ....

   - Collect some crystals using the sample bag and record the name of the station on the bag with the marker.
3. Briefly describe the process that led to the crystallization of the mineral here? ....

   ....
4. What is the energy source of the geochemical process here? ....

   ....
5. Repeat the sampling at another pool and complete the third row in the table below.
6. Sample the white substance that crystallized here. With the teacher, find out its name and chemical formula, and write it here: ....

   ....

Sampling station	Temperature of the solution	Density of the solution	Shape of the crystals	Name of the mineral
1				
2				
3				
4				
5				

Three teachers' stories of using the schoolyard as an integrated tool for elementary teaching

Kelly Feille

Texas Christian University, USA

This naturalistic study addresses the experiences of three teachers who use a schoolyard garden to teach their students. Using a narrative approach, the teachers' stories are shared and layered together revealing thematic similarities and differences. Together, they reveal some insights into learning to use the schoolyard as a component of teaching. Their stories describe a community of mentors and leaders who provide the opportunity for teachers to see successes (and failures) and gain the skills and confidence needed to take their students out, letting nature be their inspiration and their guide.

Subject:

Public schools in the United States are driven by a back to basics push that holds students to high levels of accountability on state-level and national standardized tests, "Accountability is big! Our product is our test scores" (Thorp & Townsend, 2001, p. 353). Although studies are limited and many are narrowly focused, a common theme of research of learning impacts of school gardening follows a positive trend (Blair, 2009). Even with a positive research base for school gardening, school district administrators maintain a constant cycle of curriculum reform of classroom teaching (with emphasis on the classroom). New curriculum, test prep resources, and a teach to the test mentality accompanies the drive of high stakes testing and the barriers to garden-based instruction increase. Blair (2009) suggested that this over-emphasis on fact-based knowledge creates a weakness in students' processing and critical thinking skills. The garden stands as an intervention to fact and test-based teaching.

The incorporation of garden-based teaching practices is not easy or second nature. Barriers to teaching in gardens such as lack of time, funding, support and curriculum as well as lack of teacher training and experience have been reported as standing in the way of school-based garden teaching (Blair, 2009). The safe, clean, familiar, and contained classroom feels comfortable to teachers. To incorporate outdoor instruction, teachers must become aware of new safety and control risks that place a heightened focus on their pedagogical practice (Foran, 2005). However amidst the roadblocks, 81 North Texas elementary schools include a garden on their campus and teachers are successfully using the gardens to integrate learning (REAL School Gardens, 2010).

Study Design:

The stories of John, Debra, and Sophia (pseudonyms) come from individual, semi-structured interviews. Each teacher shared with me their narrative, their experience of arriving and learning to teach at a school with a garden. Debra is a science content specialist at a public urban school in North Texas where she used to teach fifth grade science. John now teaches fifth grade math in the same school district as Debra. Sophia currently works as a literacy specialist at a small private school but began teaching in a garden at a public school in the same urban area. All three campuses have partnerships with REAL School Gardens, which provides not only garden design and installation but also teacher professional development. The stories of these three teachers are layered together to describe how they stepped into a school with a garden and got their hands dirty.

Findings:

Together, the teacher stories presented in this research reveal some insights into using the school yard as a component to teaching. Debra describes a school where she, as the sole provider for the garden, works without a community and feels constricted by a demanding and busy teaching schedule. John's story reveals a history of positive mentoring and role modeling from colleagues that allowed him to see the value of using the garden and the environment to teach his students. Sophia's story stands out. She describes an intense moment where her teaching practice changed to one led by student curiosity and interaction with the natural surroundings found in their outdoor learning environment. She became a mentor for other teachers, a leader in professional development on her campus and others, providing those same types of experiences for teachers so they too could find the value of teaching in the garden; allowing the environment to be their guide. The mentoring that Sophia provides and that John experiences creates opportunities for what Rogoff called cognitive apprenticeship (as cited in Jones, Rua & Carter, 1998). Using Vygotsky's theories of socially negotiated learning, teachers are able to place themselves in an expert-novice relationship and learn new skills and confidences from their colleagues (Jones, Rua, & Carter, 1998).

Discussion:

A "garden pedagogy" exists where the unplanned moment becomes a teachable one. When the garden is the teaching tool, all subject areas become combined through the children's motivation to explore. Aesthetics, culture, and geography are integrated into curriculum (Foran, 2005). Teachers act as facilitators rather than conveyors of knowledge. The responsibility of the teacher relies on gained experiences and fostering student inquiry rather than on stored knowledge (Williams & Brown, 2012). This type of teaching requires experiences where teachers begin to understand the value of their environment, trust in the learning process, and feel confident in their ability to guide (Moore, 1995). A single professional development opportunity may provide a catalyst for change; however, there is no book that can teach a step-by-step guide to garden pedagogy (Williams & Brown, 2012). For the teacher to make the conversion from four walls to the schoolyard, more than a single exposure is needed.

Conclusion:

The understandings revealed through these three teachers' experiences offer themselves to be of importance for those who provide professional development for teachers as well as school leaders seeking to create a culture of change within their schools. Understanding teachers' experience as they engage with the concept of change and go through a process of change in their teaching could be useful in the design of programs and experiences provided to teachers. The community that John became a part of and the one that Sophia helped to begin may make these transformations more likely. That community of mentors and leaders provides the opportunity for teachers to see successes (and failures) and gain the skills and confidence needed to take their students out, letting nature be their inspiration and their guide.

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Elementary Science Methods through School of the Wild and Ropes Courses

Ted Neal and Jay Gorsh

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Collaboration between the University of Iowa Ropes Course and Elementary Science Methods, through School of the Wild, has helped expose pre-service teachers to the value of teaching through outdoor learning environments. Through the Ropes course, teachers learn to more effectively deliver science integration needs to diverse learners while learning to be leaders and collaborators. Through elementary science methods, pre-service teachers learn how to write inquiry-based lesson plans, classroom management techniques and helping to spark a passion for teaching their future students about the outdoors, helping to address what Richard Louv calls "Nature Deficit Disorder".

Specifically, we will share how our students are exposed to these two unique opportunities and how it helps to shape their vision for effective science teaching. Additionally, we will share what impact the activities will have for helping pre-service teachers develop strategies for working with students who have disabilities while gaining greater awareness and appreciation for the rewards and challenges associated with such experiences.

Over the last three years, we have worked on two different fronts regarding teacher/student engagement with the outdoors to prepare them to effectively teach students. Elementary teachers, through their science methods course, all partake in an outdoor learning environment called School of the Wild. School of the Wild is an accredited environmental school offering immersion programs involving direct participation and observation in our natural world. They focus on ecology, science, natural history, personal growth, and team building. Their mission is to awaken an awareness of the wildlife and natural ecosystems in our area, develop and appreciation of the natural world, and encourage a balanced environmental ethic and caretaker attitude with respect for the earth. Through our science methods course work, we engage pre-service teachers in this program, teaching them how to write inquiry-based lesson plans, classroom management techniques and helping to spark a passion for teaching their future students about the outdoors, as Richard Louv calls "Nature Deficit Disorder".

We utilize The University of Iowa High Adventure Challenge Course as an effective tool in helping student leaders, public school groups and pre-service teachers become effective leaders and teams. Fun is what brings the experience to life: it helps keep people focused, engaged, and connected to each other. As an outdoor learning environment the Ropes Course allows us to challenge pre-service teachers conceptions regarding how to effectively collaborate with other professionals, in order to problem solve methods for working with groups of diverse learners. Specifically, pre-service teachers gain skills to help them differentiate in their future classrooms through their successful completion of Ropes Course Training. Teachers who are more able to engage students in diverse, problem solving learning environments see increases in their students' critical thinking skills.

Problem:

Over the years of being teachers and now working with pre-service teachers, it is clear that there is a lack of cohesion between science learning experiences as a student and their beliefs on how to teach in the future. Pre-service teachers come to science methods course with a common belief that teaching from a science kit is an effective way to teach their future students. Over the past three years, through exposure on the Ropes Course and at School of the Wild, students are learning better techniques to engage their future learners in science. Our elementary pre-service teachers have huge holes in their basic understanding of scientific concepts. Through their time in our courses, exposure to new experiences, we show them both the pedagogy and content regarding different outdoor learning experiences. As we move forward in revamping our program, specifically increasing the content knowledge requirements in elementary education, we are looking for better ways to blend the skills taught on the Ropes Course with those learned at School of the Wild to better prepare our future teachers.

Study Design:

Pilot studies have been conducted in an effort to determine effective assessment tools and activity protocols to create a dynamic experience to create opportunities for pre-service teachers to generalize what they have learned to future instructional environments. We plan utilize the research that has been done, including the Science Writing Heuristic, to blend learning opportunities, through elementary science methods, the ropes course and School of the Wild, to more effectively expose pre-service teachers to outdoor learning. We plan to conduct pre and post survey's to assess how impactful the different experiences are to improve pre-service training. Through newly remodeled courses, which come online fall 2013, we hope to offer new experiences to pre-service teachers exposing them to the value of teaching through the vehicle of experiential outdoor learning environments.

Findings:

We will be running a trial test on pre-service teachers this fall and will be able to report those findings at the ICOLE conference. However, that is a pilot test for the change we plan to implement come fall 2013.

Discussion:

The University of Iowa High Adventure Challenge Course started in 2007 and School of the Wild began in 1991. During this time, they have been individually utilized by different faculty within the College of Education. This is the first time that we've tried to bring the benefits of both programs together to help impact our pre-service teachers. We look forward to future collaboration and efforts to broaden our outdoor learning environments for our pre-service teachers.

Conclusion:

We look toward ICOLE as a learning opportunity to help the University of Iowa continue to develop our ideas on utilizing outdoor environments to effectively prepare teachers. The collaboration opportunity and partnerships with other world universities and like-minded professionals will provide invaluable support, including potential international cooperation in these areas.

How do pre-service teachers see their competence in organizing field trips?

Anne-Kathrin Lindau, Alexander Finger and Martin Lindner

Martin Luther University Halle-Wittenberg, Germany

Field trips are an important method in Geography and Biology education. However there is a lack of research on self-reflection of pre-service teacher regarding their competence in organizing field trips. One aim of this project was to measure the skill development of pre-service teachers regarding aspects of planning, conducting and evaluating field trips with students. To achieve this, a course was designed to provide pre-service teachers with theoretical information. After this phase, they had to create a station-based field trip for students of a high school on an ecosystem analysis with focus on field methods. The field trips were conducted in two different common settings. In the first setting, the pre-service teachers were responsible for supervision of the station they created. In the second setting the teachers were responsible for supervision and guidance of a particular student group throughout each station.

Results are indicating that self-confidence in planning and conducting a field trip are closely related to the responsibility the pre-service teachers had, as well as the number of supervised stations.

Subject:

Field trips are an important method in geographical and biological school education (German Geographical Society 2012). Albeit knowing of the benefits of field trips, such as authentic and practical learning paired with improving social skills, teachers rarely embed field trips in the curriculum (Lössner 2010). To make field trip more prevalent, pre-service teachers need to be trained and motivated early in their professional education. Findings in experiential based learning programs show a better impact of such methods (Kolb et al 2000). Therefore this project offers pre-service teachers first hand experiences as well as theoretical input.

In-service teachers often point out organisational and methodical problems for not conducting field trips with students (Lössner 2010, Klaes 2008). To help pre-service teachers to solve these problems, it is essential to increase their planning skills. Therefore we initiated a project to better prepare pre-service teachers, also increasing their motivation to conduct field trips in their future professional life (Kolb et al 2000).

Study Design:

Setting: If field trips are conducted in school, they are often station based or guided by a teacher (own findings). Potentials and limits of these two variations to conduct a field trip are not sufficiently researched. Therefore these two settings have been evaluated in this study. The evaluation focuses on pre-service teachers' self-reflection on their skill-development regarding planning, conducting, and how this motivates them to perform field trips with students.

The evaluation has a two-group design in which the pre-service teachers had to plan, execute and conduct a field trip with students. Group one was a station based design. The pre-service teachers where divided into subgroups and each subgroup had to design a station with regard to the overall field trip topic: the ecosystem analysis of an alluvial forest in biological and geographical terms. Therefore the stations include topics like water and soil analysis, weather data comparing the outside with the inside of the forest or plant determination with iPad-Apps. The pre-service teachers of group one were responsible to supervise the particular station they designed.

Group two was also station based, the stations designed by the pre-service teachers. In this setting the pre-service teachers were guiding a group of 9-10 students during the whole field trip. In contrast to the first group, they not only had to supervise their own station, but were in charge of guiding the work on the stations of the other subgroups as well.

Data collection: The study was evaluated by a pre-post-follow up questionnaire design. The questionnaires contained closed and half-open questions with a 5-point Likert Scale. The groups were also observed during the excursion and the theoretical sessions. We took as indicators the students' comments on their own method competence, organisational competence and motivation.

Data collected from the pupils regarding these aspects were also collected and used to compare them with the data of the pre-service teachers.

For further studies, qualitative interviews with participants of both groups were made and evaluated.

Findings:

1. Results regarding the reflection on the method competence show different results between the two groups. The members of the first group reflected their competence to be higher than the members of the second group. Results of the pupils' evaluation show the opposite: the pre-service teachers of group two were evaluated more competent as the pre-service teachers of group one.
2. Regarding the motivation to perform field trips with pupils the answers of the two groups also differ. Pre-service teachers of group one estimate themselves more confident than members of group two.
3. The interviews show that pre-service teachers value the practical experience high and that this experience is important for their motivation.

Discussion:

One reason for the differences between the two groups of students might lie in the contact time with the pupils during the field trip, as well as in the difference in the amount of work. Group two had a longer contact time between pupils and students. As the members were conducting the activities at every station, they had a higher preparation duty and a higher responsibility in guiding the pupils throughout the whole day. Members of this group show a less positive perception on their competence. As they have a broad spectrum of field-methods to perform, insecurity might be created by the demand on being an expert at all stations.

Members of the first group on the other hand only guided the pupils at the station they created. They had a limited responsibility in guiding the pupils during the day, working with one pupils' group after the other. The members of this group show a positive perception regarding their competence, but a limited overview on field methods.

This is also indicated by the pupils' evaluation. Pupils evaluated the performance of the second teacher student group in all aspects as being better than those of the first group, which might also be a result of the longer contact time. Another variation in the results might be created by the fact that the pupils in the first setting had contact with many different pre-service teachers over the day, which makes it more difficult to get reliable answers.

On the motivation of the pre-service teacher to conduct field trips a general increase is shown comparing the results of the pre- and post-test. But here as well the participants of group two were less certain. A factor that might be influencing their self-confidence is the stress level. As mentioned before, the second group had more duties to carry out which created more stress, which might decrease the motivation to perform a field trip again.

Conclusion:

The practical experience in field trip education can be used to prepare and motivate future teachers. Our results indicate that the setting according to the first group – in which the students prepare only one station - is more effective to motivate pre-service teacher to perform field trips. However, interviews and observation show that the setting of the second group – in which the teams prepared one station, but guided a pupils group along all stations over the day - also has advantages. The students show a broader knowledge about field methods and how to conduct them with pupils.

In general the practical aspects of this project and the experiences were highly ranked by the pre-service teachers. In future projects the setting of the second group will be used for further tests.

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Professional Development in STEM and World Language Via Problem-Based Learning To Support an Environmentally Responsible, Global Citizenry: Far East Russia and the United States

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In this study we share aspects of a professional development program for Science, Technology, Engineering, and Mathematics (STEM) and World Language (WL) teachers participating in a teacher exchange program operating in Far East Russia and the United States. Twenty Russian and 18 US teachers participated in the study. Of these, all twenty Russian teachers and five US teachers traveled to the partnering country for field experience in participants' schools. Additionally, teachers participated in professional development that was designed and led by local university faculty, teachers, and school administrators and included a cultural component to explore a variety of indoor and outdoor community resources. The program targets STEM and WL teachers to encourage an integrated approach to science and language learning in the context of problem-based learning involving issues of local to global importance, such as environmental issues. Data were collected through electronic surveys, direct observations, portfolios, and focus group interviews. Data highlight the positive impact of the project on teachers' knowledge of how instruction in science and language can be integrated to provide a context for meaningful learning and a means of communicating findings. From the data, examples of teachers' practice provide evidence for how outdoor learning experiences supportive of students' identification of an environmental concern, authentic data collection, sense-making, and development and communication of data-driven solutions can be a foundation for problem-based learning to support students' integrated STEM and WL learning. Data also illuminate the importance of developing a social network of support for teachers focused on a mutual exchange of ideas that incorporate environmental science issues of local to global significance in order to sustain the effects of teacher professional development support.

Subject:

Standards for the professional development of teachers have been designed to provide guidance in the most effective educational approaches for the development of teacher leaders that are consistent with education reform and sustained for long-term effects that extend beyond the actual time of the actual professional development experience. This study is focused on teacher professional development that integrates the fields of science, technology, engineering, and mathematics (STEM) and the field of World Languages (WL) at the secondary level (grades 6-12 in the United States and 5-11 in Primorsky Krai region of Far East Russia) in the context of problem-based learning as an opportunity for developing secondary students' behaviors and attitudes as responsible, global citizens of the 21st century.

Today's K-12 students will need to be capable of working and living in a changing world (National Center on Education and the Economy, 2007; National Research Council, 2007), which is apparent both in Far East Russia and in the United States. Indeed, Vladivostok, the largest metropolitan area in Primorsky Krai of Far East Russia, will host the Asia-Pacific Economic Cooperative's 2012 Summit in October 2012 (APEC, 2012) and serves as the site of the Russian Federation's Navy headquarters and is situated in a region of diverse outdoor community resources. To support our future global citizens' development of internationally mindedness and ability to communicate important information across cultures and languages, professional development that encourages interaction among teachers on a global scale is needed.

Design:

Twenty Russian teachers from Far East Russia and 18 U.S. teachers from the mid-Atlantic participated in the study (total of 22 STEM teachers and 16 WL teachers). Of these, all twenty Russian teachers and five U.S. teachers (four STEM, one WL) traveled to the partnering country for field experience in participants' schools; professional development designed by university faculty, in-country partners, and local education administrators; and a cultural component designed by university faculty in cooperation with in-country partners that canvassed a variety of indoor and outdoor community resources. The program theme was "teacher leaders think systematically about their practice and learn from experience." Figure 1 provides an overview of the program's components. During the Russian teachers' four-week visit to the U.S. in the Fall of 2010, both Russian and U.S. participants attended professional development seminars, experienced practical classroom-learning opportunities, visited indoor and outdoor community resources, and engaged in reflection on teaching and education. Participants from the U.S. made a two-week reciprocal visit to Russia several months later, where they also experienced practical classroom-learning opportunities, visited indoor and outdoor community opportunities, and continued their collaboration on joint projects anchored to their classrooms to build on the professional experiences established during the Russian participants' visit. Russian and U.S. teacher participants also worked to conduct a teacher research conference in Far East Russia focused on the implementation of these new projects and to share the results of investigations in their U.S. and Russian classrooms.

The study explored the following research questions: (1) To what extent did program components encourage intercultural understanding and a mutually respectful exchange of ideas about the nature of teaching to foster professional growth and systematic reflection focused on enhanced teaching practice?, (2) What were the challenges for collaboration among teachers participating in professional development in an international setting and how could a cultural component utilizing a variety of indoor and outdoor community resources be utilized to navigate these challenges?, (3) What are the long-term effects of the professional development and the resultant implications for the program's sustainability efforts?

For this qualitative-based time series study, multiple sources of data were collected through Summer 2012. Data included a series of intervals of observations of classrooms and seminars conducted during the Russian teachers' visit to the U.S. and the U.S. teachers' visit to Russia; electronic surveys of teachers; focus group interviews during debriefing sessions; an analysis of teachers' emails and responses on the program's social networking group created on Vkontakte.ru, which is a Russian social networking site comparable to Facebook.com©, and participants' Facebook© postings outside the program's private group; an analysis of teachers' electronic portfolios; and an analysis of teachers' presentations during a culminating teacher researcher conference in Vladivostok.

Findings:

Collaborative Instructional Planning and Action Research: Cumulative data indicate an increased, sustained emphasis on collaboration between teachers of STEM and WL that they attribute to their participation in the program. Collaborative planning between Russian teachers in WL across a broad geographic region has resulted in co-presentations of instructional ideas at language conferences, between STEM and WL teachers that support language learning in the context of outdoor learning opportunities, plans for students' sharing of environmental data explored during students' science and WL courses, and between Russian/U.S. EFL/WL teachers that explore effective strategies for language instruction with results shared at conferences. There is ample evidence to document teachers' continued use of online social networking for support and collaboration among their cohort along with how action research served as a collaborative planning opportunity that allowed for an enriched use of indoor and outdoor community resources in both countries.

International Community of Learners: Early findings illuminated the teachers' increasing participation in the in-country exchange components and follow-on experiences supported via technology, showed how a mix of indoor and outdoor experiences supported common experiences and collegiality necessary for the development of a positive community of learners among the program's teachers, in-country partners, and university faculty in both the U.S. and Russia dedicated to integrated STEM and WL instruction. This community of learners provides opportunity for STEM and WL to learn from one another, collaborate toward common instructional goals that integrate STEM and WL instruction with a focus toward purposeful instruction in a global context of real world consequence, and further develop personal and professional characteristics of international-mindedness necessary to meet learners' needs in 21st century's global, diverse economy.

Discussion:

This study provides evidence of the positive impact of internationally-focused professional development efforts involving a partnership of STEM and WL teachers on teachers' understanding and students' content knowledge, teachers' science teaching efficacy, teachers' understanding of authentic language development in the context of problem-based learning and examples of how outdoor learning focused on environmental science issues can support co-planning and co-teaching behaviors. Additionally, the study's findings result in a series of data-driven suggestions for future professional development efforts designed to support teachers' ability to meet the challenging needs of students in the 21st Century which will be shared and discussed with peers at the conference

Conclusion:

Science teacher educators/researchers struggle to develop, implement, and assess effectiveness of programs designed to support quality STEM and World Language instruction at the secondary level. By examining a program that purposefully joined STEM and WL teachers so that each could learn from the other, this study illustrates the positive outcomes resulting from quality professional development situated in two countries with an ultimate goal of fostering teacher leaders at the international level transcending barriers of language and geography. In light of the necessity for schooling to support students' environmentally- responsible attitudes and behaviors as global citizens, it is this type of authentic learning that should form the basis of what we do as contemporary and future-minded educators.

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References Provided on Request

Figure 1. Overview of Program Components

Spring	• Recruitment and selection of ten STEM and ten WL Russian participants • Recruitment of U.S. teachers as partners during field experience
Late Summer	• Pre-departure orientation in Primorsky Krai for participants traveling to U.S. • Russian participants apply for visa to travel to U.S.
Mid Fall	• Russian participants travel to Washington, D.C., for four weeks • Professional learning seminars • Cultural component incorporating both indoor and outdoor community resources • Field experience at partner school with an assigned partner teacher • Daily debriefing facilitated by program co-directors • Create electronic portfolio, digital PhotoStory©, follow-on teacher research plans
Late Fall	Recruitment and selection of one STEM and four STEM U.S. participants
Winter	Collaboration between Russian and U.S. participants on collaborative, follow-on teacher research via portfolio, Blackboard©, VK.com-Vkontakte.ru, Facebook©, email, Skype©
Spring	Pre-departure orientation in U.S. for participants traveling to Russia
Mid Spring	Five U.S. participants travel to Primorsky Krai, Russia, for two weeks • Professional learning seminars • Cultural component incorporating both indoor and outdoor community resources • Field experience with debriefing • Continuing portfolios, photostories, and follow-on teacher research • Follow-on Conference: Teacher Researcher Day (Additional US teachers via videoconferencing) • Panel discussion on Russian/U.S. education, Description of follow-on projects and findings, and next steps
Late Spring	Dissemination Seminar in U.S. (Russian participants attend via videoconferencing) • Panel discussion on Russian and U.S. education systems, Description of follow-on projects, Teacher research findings, and Next steps for continuing collaboration
Summer	Collaboration between Russian and U.S. participants on follow-on teacher research via technology
Schoolyear	Implementation of collaborative teacher research; documentation via electronic portfolio
Summer	Survey of professional development effects, social networking, and collaborative planning

Green Schools' Outdoor Learning Environments as Mean of Promoting Environmental Identity

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Environmental education (EE) is relatively a young area. In Israel, EE is still evolving and transforming. Educational initiatives such as the 'Green School Program' were formed in order to promote sustainable development (SD) and active environmental citizenship. The 'Green School' conception is based upon 'cultural ecology' (Orr, 1992) and 'Place-based education' principals (Dunitz, 2004). According to this approach, the unique characteristics of a certain place constitute the core of pupils' and teachers' experimental learning. Gruenewald (2003) states that pupils tend to lose 'feeling of place' if the learning process doesn't focus on their immediate surroundings.

To that extent, the 'Green School Program' aims to adopt a long term educational process where teachers, students and school management will assimilate a school culture based on environmental principals.

Outdoor learning is one of the pedagogical means in which green schools strive to achieve this goal. School curriculum corroborates outdoor activities, both in and out of school, as an integral part of school's life style and provides the environmental learning experience an additional dimension.

This research examined the implementation of green school programs in relation to students' environmental literacy in terms of its three major components: knowledge, attitudes and behavior.

Research findings indicate that implementing green school programs might promote pro environmental behavior. The study shed light on the importance of using outdoor learning environments regarding the process of creating an environmental identity (Thomashow, 1996) and the encouragement of pro-environmental activism.

Research aims:

a. To examine the students' conceptions regarding environmental issues.

b. To compare students' pro-environmental behavior, environmental attitudes and level of environmental knowledge in three different types of schools (control, green, diligent green).

c. To characterize the different factors within the "Green School" program that affect students' environmental literacy.

d. To evaluate the effectiveness of the "Green School" program in urban elementary schools in terms of its impact on environmental literacy.

Study design:

The study adopted a mixed methods approach and was conducted as a case study. The research population consisted of 144 students in the 6th grades from three urban elementary schools in the center of Israel: a 'control' school – which did not participate in any environmental program, a 'green' school, and a 'diligent green' school which implemented green school programs as defined by the Israeli Ministry of Education.

By combining both qualitative and quantitative procedures, this study practices the concurrent triangulation strategy in which two different methods cross-validate or corroborate findings within a single study. The three school types chosen for the research, having similar background characteristics, were located in a city in the urban center of Israel.

The current research was conducted in two stages:

Stage 1: Quantitative

Research method included a close-ended questionnaire. It used a questionnaire that has been served as a national survey for the sixth and twelfth grade students in Israel (Negev et al., 2008). The questionnaire included 81 questions and was distributed to 6th grades from six classes (two from each type of school: control, green and diligent green schools). The data collected were statistically analyzed using SPSS v.17 and STATISTICA 8.0.

Stage 2: Qualitative

The research methods included semi-structured interviews. 24 students (8 students from each school) were interviewed at the second semester of the school year. The interviews followed an interview guide, which included 13 questions. The questions were designed to elicit more information about the student's perception regarding environmental issues. The data collected were coded by themes, following the grounded theory framework (Charmaz, 2000) and then content analyzed. Three themes: knowledge, attitudes and behavior were divided into categories which represented best the students' answers in the interviews and portrayed their perceptions in relation to environmental issues.

Findings This study sought to characterize the unique effect of green school programs as perceived by the students. Both quantitative and qualitative tools indicate that green and diligent green school students tend to be more involved in pro-environmental projects in their schools. Participating in green school councils and initiating outdoor learning activities empowered students. Students from green schools were found to be more aware and involved in environmental outdoor activities compared to students in the non-participating school, where only a small group of students took part in performing environmental activities. Outdoor activities in green schools became an integral part of the learning process that takes place within or outside school premises. Moreover, students from green schools spent more time in outdoor activities compare to the non-participating school.

Implementing green school programs has been found to affect school's curriculum by becoming multidisciplinary oriented where environmental issues are interconnected. Outdoor learning activities in green schools were expanded to school's community where students tend to demonstrate active citizenship behavior and contribution to school's community.

Discussion and conclusion The aim of the study was to achieve a better understanding regarding the way students explain and conceive environmental issues and closely look into the "Green School" program and define its unique characteristics.

Implementing green school programs provide the students more opportunities to experience nature both in and out of school. Practicing outdoor activities allow the students to be in touch with nature and develop their environmental identity, which encourage pro-environmental activism. All school type students expressed their wish to have more outdoor activities and spend more time in the outdoors.

Bonding with nature is also apparent visually in the green schools' premises: large petting zoo, an ecological garden, large bird dovecotes enables students to truly feel and understand the meaning and importance of environmental preservation and practice it by manifesting responsible environmental behavior (REB). To that extent, green schools practicing long-term outdoor learning activities, especially in local familiar environments, have the potential to form a 'place attachment'(Gifford, 2002) which emphasizes the manner in which we personally construct our notion of place.

As a diligent green school principal and as an educator the research findings reinforce my believing in the capacity of the educational process to serve as means of social-behavioral change.

*References - on demand

Thursday – February 7, 2013

07:00	*Breakfast*
08:30	**Interactive session – Hotel** » **V. Elderton:** Synergies within contextual outdoor learning environments & immersive curricula » **N. Even:** Thoughts and conclusions after 6 years of on the job training, of outdoor learning. » **T. T. Nielsen:** Serendipity as the means to investigate the city – a new look at Psychogeography. » **R. Oser:** Effectiveness of virtual laboratories in terms of learning environment, attitudes and achievement among high school genetics students. » **D. B. Zandvliet:** Action Research and the Place-based Learning and Constructivist Environment Survey (PLACES)
10:00	Traveling to **Jerusalem**.
11:00	**Outdoor demonstration:** Gilo junior high school educational yard
13:00	**Mahana Yehuda market:** An educational lunch break (with worksheets)
14:30	**The Old City** – a free tour
16:00	Moving towards Rehovot
17:30	Arriving at the hotel (Leonardo) and getting settled
19:00	*Dinner party and closure*

Synergies within contextual outdoor learning environments & immersive curricula: North Vancouver Outdoor School a Case Study

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North Vancouver Outdoor School, Canada

Affiliations: Principal co-Administrator North Vancouver Outdoor School (SD 44), Director of Environmental Educators of British Columbia, Board Member of the Association of Nature Center Administrators, Advisor UN University – RCE in Education for Sustainable Development – Institute of Environmental Learning Vancouver BC

Abstract: Since its inception in 1969, the North Vancouver Outdoor School (NVOS) has provided an interactive experiential learning environment for students, in-service teachers, practicing educators, science researchers and social science researchers. The underlining purpose of the school in its park-like setting is to be a centre of environmental leadership, learning and dialogue. The centre's pedagogy provides direct experience opportunities for outdoor hands-on curriculum development and curriculum implementation for young learners, graduate students, adult learners and researchers.

Within this educational context learners utilize the various natural resources of the site as its outdoor classroom; such as its 165 ha (420 acre) ecological preserve, 14 km (8.6 m) of wild salmonid habitat and spawning channels of the Dave Marshall Salmon Reserve, three zones of coastal temperate forest including 1,000 year western red cedar grove, largest known habitat for wintering bald eagles in North America and the pacific flyway for spring migration of rufous hummingbirds. Studies in these natural areas are further enhanced by specialized contextual teaching facilities that include "Save the Salmon" hatchery, bio-diversity heritage farm and Skw'une-was traditional first nations Coast Salish Bighouse.

This presentation examines place-based outdoor learning and the on-going development of NV Outdoor School. This includes its most recent as well as future re-vitalization emphasizing the integration of experientially based curriculum with site access and contextual facilities.

Conference Theme: Factors that influence the effectiveness of the outdoor learning environment

Key Words: experiential, outdoor, environment, contextual learning facilities

Subject:

Examination of learning and educational impact for multiple learners within the context of outdoor learning environments that integrate program implementation with site access, curriculum development and facility design.

Study Design:

Over the past 4 decades numerous quantitative and qualitative naturalistic studies regarding the impact of outdoor learning at NVOS have been conducted.

This study is a synopsis of those multiple studies from ecological, natural science and social science educational perspectives. Analysis utilizes meta-analysis rubric delineation to investigate the learning outcomes of multiple outdoor learning environments and their possible impact on deepening knowledge and understanding.

Findings:

This analysis illustrates how direct experiential outdoor environmental learning is applied across disciplines. It also examines how the specific information gained through those studies informs learner understanding and interpretation of the environment in specific outdoor learning sites within the North Vancouver Outdoor School.

In a more general way this study also provides insight into the broader context of how outdoor learning environments help inform the learner's and broader society's understanding of the world, and in turn help education researchers better understand best practice and site design of outdoor learning environments from natural, cultural and sustaining system perspectives.

Discussion:

If a goal in education is to expand our understanding of the world and enhance the depth of learning provided to all learners this study examines multiple approaches to such a goal. Data collected through this synopsis provides insight with respect to educational impact across disciplines of outdoor learning environments.

Evidence provided through this study helps inform a wider discussion toward improving overall educational practice, and encourages dialogue specifically related to the importance of connecting diverse outdoor learning environments with natural patterns of human learning.

Conclusion:

The overall analysis of this study illustrates the extent of learning from multiple disciplines that can occur in outdoor learning environments. This study also questions how those learning environments not only enhance knowledge but also can be intrinsic to gaining understanding and acquisition of knowledge.

Thoughts and conclusions after 6 years of on the job training, of outdoor learning

Noam Even

The Didactic Team LTD, Israel

Between the years 2004-2009 more than 700 teachers in 35 elementary schools had training in outdoor learning. Courses of 28 to 168 hours.

The main idea was: leaving the class for learning, is justified only when the lesson is combined in the syllabus and includes demonstration.

Another principle was – the teacher must plan and teach the outdoor lesson.

The training took place in the teachers' room. It began with theoretical background, and continued with developing lessons and having colleagues' feedback. In most schools the highlight of the course was ***a whole school outdoor learning day***, at a site close to the school.

During the fourth year we conducted a research that revealed some interesting facts.

We found, that most of the teachers (94%) were familiar with the definition and meaning of outdoor learning, prior to the training. And understood that it is important and educational to take the students out side the classrooms for learning. Most of them never left their classes for learning. More then 70% stated that after the training, using the method will become a routine.

During the first year, after the course, 12 schools (40%) continued to have outdoor learning days. Later, the outdoor activities faded away.

We concluded that teachers understood the ideas and the importance of outdoor learning. They also expressed that it was coefficient learning and demonstration. In reality, they did not continue teaching outdoors. Therefore we can say that the idea and the method are not suitable to the educational concept in the education system.

Learning outside means looking for the students' potential. Adopting it obligates changing the routine. Such learning is possible only with the governmental systems' backup.

Serendipity as the means to investigate the city – a new look at Psychogeography

Thomas Theis Nielsen,

University of Roskilde, Denmark

Psychogeography was first coined by the French situationists and lettrist in the 50's as the study of the precise laws and specific effects of the geographical environment, consciously organized or not, on the emotions and behavior of individuals. It has been used and addressed in numerous studies since both as a method to approach the city, but also as an object in its own rights. However, psychogeography, through its close relations to SERENDIPITY and it focus on the personal experience as you explore the city necessitates a close relationship between the city and the explorer. Hence, the city becomes a geographical lab that must be explored through presence and observation. Today, psychogeography – and the newer, somewhat more contemporary mythogeography, are both greatly assisted by the emergence of mobile phones containing locating services (GPS) and readily available internet and both hold a strong promise as a tool in place based learning situated in the city.

Subject/Problem:

In this study we wanted to challenge the student's ability to navigate and understand the structures of the city while at the same time understanding important issues of scale, place and globalization. We wanted to challenge general perceptions of neighborhoods in the city and to challenge the students to find in the public spaces signs and traces of cracks in the city, to re-investigate frozen meanings of places and to realize that no place is out of touch with all other places. At the same time we wanted to explore the option of using mobile phones as a learning tool in place based teaching while avoiding the use of too closely guided experiences.

Study Design:

At the onset of the semester we took the newly enlisted post graduate students to the city of Copenhagen. A total of 28 students participated. Of these 7 were foreign exchange students with no prior knowledge of the city. The students were divided into three groups. Each group was equipped with a notebook, an envelope containing some instructions and tasks to be addressed and a smartphone. On the smart phone the APP Serendipitor was installed. Serendipitor is a small route generating APP that uses Google Maps API to guide the user from point A to point B. However, where most APPs will take you via the shortest route Serendipitor will generate a more or less random route to follow. At the same time the APP will issue instructions along the way. These are small instructions that should be carried out as you transverse your route and may have an influence on the actual route travelled. This should help you to find things that you were not looking for.

This approach raises a series of questions of a more theoretical concern. The use of contemporary technology is relatively new in studies of the city and its usefulness as a teaching tool is not properly documented. Also, the employment of serendipity as a means to explore the city was not a part of the psychogeography as Debord although he was greatly inspired by the ideas of the flaneur, strolling the city, observing while at the same time being observed.

Apart from the APP installed on the phones of the students, each group was also issued an envelope containing three extra tasks.

First task was to stop en route at a random spot and to connect trodden pieces of gum and other debris on the pavement using a piece of chalk. The connected spots on the pavement should form a map. Next task was to stop at a random location and note on a world map all the places on the map that they could was present at the location where the students were at that instant. Finally, we asked the students to stop at a random location and to collect a small souvenir from that location. These three tasks along with the route issued by the APP formed the data collection that the students were undertaking.

The setup of the study was aimed at investigating the power structures of the city, to bring to the foreground some of the power brokers in the shaping of the city through its lasts couple of hundred years. The point of departure was the Citadel that today houses the Chief of staff of the armed forces, some staff functions as well as the intelligence service. Lately, The national monument to Denmark's international effort(s) has been built inside the citadel. This was the starting position of the tour. From there each group was send to a different location. One group was send to the headquarters of the freemasons, one group to the front of the office building of the high courts, while the last group was directed to a newly erected food court shopping center. Once there the groups were instructed via SMS to proceed to an iconic location in the city that used to house the extreme left wing. This house was demolished some 5 years ago under a lot of protests and civil unrest. Today, an empty lot, devoid of any activity save for a few parked cars is all that is left of the trademark of the extreme left squatters. Fear of vandalism apparently drives possible investors away. Hence, all groups would have visited places in the city that in different ways would illustrate and illuminate the continuous struggle for power in the city.

Findings:

We are still in the process of gathering all the information back from the students. This means that the results presented below are still very preliminary. However, it is clear that while the foreign exchange students enjoyed a walk in the city and the company of students who knew the city very well, they did not fully understand what was going on and did not appreciate the continuous scale jumping and bending that was intended during the walk. Amongst the Danish students, the results were mixed. Some students reported that it had been a new way of seeing the city, of experiencing the city, of noticing small things not expected. Other students were very unimpressed by the walk and the tools employed.

Brief Discussion:

The use of mobile phone technology as a learning tool in place based education was somewhat unsatisfactory as many students reported back that they would have preferred not to use the APP. Other students said it was a good tool, but that the APP should be fine-tuned to suit local conditions. Also, some students were very enthusiastic about the theoretical foundations of the walk, but some were not. This probably relates to the fact that amongst the students were post graduate students from physical as well as human geography. Those studying physical geography tends to be unimpressed with studies on urban issues.

However, most students seem to agree that not having a trained tour guide, teacher or instructor around greatly benefitted their experience and sense of the city.

Still, it is clear that much can be improved in terms of using a derivé APP such as Serendipitor, but based on this experiment it also seems obvious to suggest that the use of mobile technology in place based education of urban explorations holds many promises, not least the absence of otherwise ever-present teacher.

Conclusion:

I've been thinking on the way that it was the most random thing I've ever done … reports one of the students. This highlights the conclusion of this (preliminary) study that while some of the students appreciate the use of mobile phone technology most students failed to appreciate the details of the investigation and related to the use of their phones mostly as a facilitator of random events. This indicates that the use of mobile phones and APPS, such as Serendipitor, as a learning tool still needs a lot of attention and development. Also, the way in which the technology is used in place based learning should be reevaluated in order to further the students learning about the issues of the field trip; in this case the multi-facetted nature of their capitol. We do however remain convinced that the technology holds great advantages in place based learning and teaching!

Effectiveness of virtual laboratories in terms of learning environment, attitudes, and achievement among high school genetics students

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As our society becomes increasingly technological, research suggests that students, too, benefit from technology-rich learning environments. In an effort to both allow students laboratory experiences that would not otherwise be possible in high school settings, and to augment the integration of technology within science classrooms, virtual laboratories can be used to simulate real laboratories and encourage students to employ scientific thinking skills. This study investigated the effectiveness of such virtual laboratories in terms of students' perceptions of the learning environment, attitudes towards science, and achievement. Classes of students who utilized virtual laboratories were compared with classes of students who did not. Data were obtained by administering a questionnaire measuring students' perceptions of the learning environment, attitudes, and achievement; this was complemented by data from interviews with students. No significant differences were found between instructional groups indicating that the promise of such technological interventions in the classroom might not fulfilled but that neither does the use of virtual laboratories negatively impact students.

The results of this study inform practical teaching and learning methods in addition to adding to the body of knowledge in the field of learning environments.

Subject:

The National Science Foundation's Task Force on Cyberlearning proposes upgrading the state of Science, Technology, Engineering, and Mathematics (STEM) education by incorporating interactive technology, with one such example being virtual laboratories (Borgman, et al., 2008). Although some projects have begun, several researchers note the lack of empirical evidence concerning the effectiveness of using virtual laboratories and acknowledge the necessity to conduct controlled studies (Hofstein & Lunetta, 2004; Javidi, 1999; Ma & Nickerson, 2006). While there are a number of studies that have assessed such educational innovations from the field of information technology, there is a dearth of evaluative research on virtual laboratories from an educational perspective, especially within a learning environments framework.

Therefore, the purpose of this study was to evaluate the effectiveness of the use of virtual laboratories as an alternative laboratory environment in high school science classes, in terms of perceptions of the learning environment and student outcomes such as attitude towards science and achievement. The specific research questions were:

1. Are scales from the Technology-Rich, Outcomes-Focused, Learning Environment Inventory (TROFLEI), Science Laboratory Environment Inventory (SLEI), and Test Of Science Related Attitudes (TOSRA) questionnaires valid and reliable when used with a sample of high school students taking biology in the US?
2. Are there associations between the perceived classroom learning environment and student outcomes of achievement in and attitudes towards science?
3. Is the use of virtual laboratories in high school science classes effective in terms of students' perceptions of their learning environment, attitudes towards science, and academic achievement?
4. Is the use of virtual laboratories differentially effective for males and females in terms of their perceptions of their learning environment, attitudes, and academic achievement?

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This study draws on and contributes to the field of learning environments, which focuses on the psychosocial characteristics in the classroom, or specifically, the intangible aspects that give the classroom a characteristic tone (Fraser, 2001). It emphasizes the students' perceptions of the classroom environment as assessed by quantitative surveys. While the field of learning environments has grown over the last 40 years, a more recent direction within this field has used learning environment scales in providing criteria of effectiveness for evaluating educational innovations. Past studies have also indicated positive associations between the learning environment and student outcomes (Fraser, 2012). Thus, this study used learning environment variables as both criteria of instructional effectiveness and as predictors of students' affective and cognitive outcomes in this study.

Design:

A quasi-experimental design was used to compare students who utilized virtual laboratories with students who did not. US teachers from grades 8 - 11 volunteered their classes to participate in this study (N = ~ 300 students, 6 teachers) over a twelve-week period. The experimental group, engaged in virtual laboratories interspersed throughout the quarter. Virtual laboratories are simulations that employ 'point-and-click' techniques for manipulating various laboratory materials. Each of these virtual experiments simulated a real, hands-on experiment and followed a typical experimental format in which students observe phenomena, formulate hypotheses, set up controls, follow procedures, test hypotheses, and analyze results. The control group, continued to learn using traditional methods possibly including 'wet' labs, demonstrations, the textbook, projects, etc.. Both the experimental and control classes were taught by the same teacher and studied the same content (i.e. genetics) to ensure that the two groups were comparable with respect to the range of academic capabilities, socio-economic status, gender, and the physical classroom environment.

As recommended by a number of researchers in the field of learning environments

(Fraser, 2012), this study gathered both quantitative and qualitative data. A modified 30- minute questionnaire, the Laboratory Assessment in Genetics (LAG), consisting of items that assessed students' perceptions of the learning environment, attitudes, and achievement was administered, in either an online or paper version, at the end of the quarter in all classes. Scales on the LAG were borrowed from previously validated and often-used questionnaires in the field of learning environments: the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) (Aldridge & Fraser, 2003), the Science Laboratory Environment Inventory (SLEI) (Fraser, Giddings, & McRobbie, 1992), and the Test of Science-Related Attitudes (TOSRA) (Fraser, 1981).

Responses for these eight scales were on a 5-point Likert scale. Finally, the questionnaire also included 10 items from previously administered standardized science achievement tests that had already been validated. Qualitative data were obtained through semi structured interviews using standard protocols and students from both groups were selected for interviews.

Findings:

The LAG was found to be valid and reliable by checking the questionnaire's internal structure through factor analysis, internal consistency reliability, discriminant validity (mean correlation with other scales), and ability to differentiate between classrooms. Regarding associations between the dependent variables, simple correlation studies and multiple regression analysis were used. Learning environment scales correlated significantly and positively with students' attitudes and some of those scales (Integration, Material Environment, Teacher Support, Differentiation) also correlated significantly with students' achievement. In response to the third and fourth research questions concerning whether the use of virtual laboratories was effective and also whether it was differentially effective for different sexes, a two-way MANOVA was applied to check for significant differences and effect sizes were calculated to determine the magnitude of such differences. Students in classes that engaged in virtual laboratories did not report statistically significantly higher scores on any scales than students in classes that did not engage in virtual laboratories. However, there were some small, positive significant differences between males in classes that engaged in virtual laboratories and males in classes that did not (for the scales of Material Environment, Teacher Support, and Inquiry), while females fared better in the control condition.

Qualitative data explained that such results might be due to male proclivity towards video games and virtual environments but that generally, all students preferred a hands-on environment.

Discussion:

Because no significant differences were found between classes that engaged in virtual laboratories and classes that did not, it is possible that this educational innovation can be disregarded as being of limited benefit to students. Especially in today's technological society, efforts and resources might be better spent on initiatives that increase the 'hands-on' experiences of students away from the virtual world and towards the real world. This study was significant because it provided evidence that such technological interventions might not be worth their investments. Such a conclusion can inform developers of educational media, policymakers, administrators, and teachers on how to better educate students with limited resources. Additionally, another questionnaire that evaluates the learning environment was validated, which can hopefully be applied to research in other contexts.

Conclusion:

These findings add to the growing body of knowledge within the learning environments field in that learning environment scales were further validated, associations were found between perceptions of the learning environment and attitudes towards science and achievement, and an educational innovation was evaluated. This study suggests that virtual laboratories can be incorporated into science curricula without detrimental effects. The added advantages include that virtual laboratories are also an efficient, safe, and cost-effective alternative to running physical laboratories for experiments that students might not otherwise access because of limited funding and maintenance. In summary, the results of this study indicate that virtual laboratories cannot replace hands-on experiences in science classrooms, despite the promise that technological innovation supposedly portends for educational settings. Further research into this topic might shed light on how the benefits of virtual environments might be blended into traditional classrooms without sacrificing the 'hands-on' element.

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Action Research and the Place-based Learning and Constructivist Environment Survey (PLACES)

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Preliminary studies at the intersection of environmental education and learning environments research have noted that in some cases, students' perceptions of preferred and actual learning environments have a much closer fit in interdisciplinary, experientially-based settings than in traditional classrooms. These earlier findings spurred the development of a more robust instrument for use in a variety of environmental education settings. This paper reports on the development and validation of a specialised learning environment instrument: the Place-based Learning and Constructivist Environment Survey (or PLACES). The findings from this study confirm the reliability and validity of the new instrument for assessing environments in a variety of contexts including elementary, secondary and post-secondary settings and has further enabled many forms of participatory action research involving teachers and informal educators.

Objectives:

The objectives of this research program are to develop tools and processes for measuring, evaluating and describing environmental and place-based education programs and their associated learning environments; 2) To provide rich and extensive descriptions (quantitative and qualitative) of how these settings can be characterized and how they differ from other types of learning in classroom based settings and; 3) to devise interventions, detail how they unfold in extensive case studies, and evaluate how they impact learning, learning environments, teacher engagement and community effects.

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Conceptual Framework:

In some of the earliest work on human environments, Rudolf Moos (1979) stated that interest in the physical and social aspects of planning human environmental systems such as towns, workplaces or public institutions was steadily increasing and this is still true today. Moos saw this concern as being responsive to the technological changes which (are) effecting large-scale change in society. He suggested that this created a need for a model to conceptualise and assess these environments. Walberg (1979) claimed that the evaluation of teaching based on structural and behavioural theories required perceptual measures of what he termed the 'feel of the class'. He noted that the analysis of behavioural complexes with educational perceptions may eventually begin to characterise important aspects of the social learning environment. Learning environment studies seek to describe educational contexts and to identify empirical relationships among subject matter (curriculum), teaching practices and various environmental variables.

The study of learning environments is now a growing field of academic inquiry and although it most prevalent within science education, it has application possibilities in many different areas and I assert that it is particularly applicable to inter- or multi-disciplinary fields of study such as environmental or place-based forms of education. Since it's beginnings over 30 years ago, learning environment instruments have been developed, tested and validated in a variety of settings and in a variety of countries (Fraser, 1998). These instruments have been made up of scales that are used to identify specific constructs in the learning environment. Examples of these include: student cohesion, teacher involvement, material environment, cooperation, task orientation and equity. Each scale typically consists of items designed to evaluate a specific aspect of the learning environment. Over the years and in a variety of different countries, various scales have been designed validated and tested.

Place-based Education:

The notion of a place-based education has been well described by Soble (1993; 1996) and others have expanded these ideas (Grunewald, 2003; Hutchison, 2004; Orr, 1992, 1994; Thomashow, 1996; Woodhouse & Knapp, 2000). Describing exactly what constitutes a place-based education becomes clouded partly due to the multifaceted and interdisciplinary nature of the literature where this notion seems to reside. Grunewald (2003) writes that the idea of place-based learning connects theories of experiential learning, contextual learning, problem-based learning, constructivism, outdoor education, indigenous education and environmental education. This paper relates how learning environment methodologies can be employed effectively in place-based and environmental education studies and relates the development of a valid and reliable tool for this purpose.

Methodology:

Fitzpatrick et al. (2006) have identified five distinct approaches to evaluation: objective-oriented, management-oriented, consumer-oriented, expertise-oriented, and finally, participant-oriented approaches. The latter model was selected for this research design because it responds to the needs of participants in a program while having the following advantages: inductive reasoning; multiplicity of data; emergent planning; and acknowledgement of multiple rather than single realities (Fitzpatrick et al., 2006, pp. 133-134). Participatory approaches (e.g., Stake, 1967) can use description and judgement to provide background, justification and description of a program rationale while also listing and recording intended antecedents, transactions and outcomes. They also explicitly state standards and record judgements. In contrast, Guba's and Lincoln's (1981) naturalistic evaluation approach uses: ordinary language; focuses on participants, uses everyday categories, is based on information rather than logic, studies program in situ, and cross-checks for triangulation.

Reflecting on the process of tool creation for this research program and the reliability and validity problems encountered with earlier instruments, a decision was undertaken to create a more robust instrument for use in place based and environmental education settings. The new instrument is the Place-based Learning and Constructivist Environment Survey (PLACES). During its development, we employed a participatory approach in the evaluation of the learning environment literature and various published instruments. A series of focus groups conducted over a period of 4 months (with teachers and informal environmental educators) resulted in a consensus around eight constructs which were deemed most important to place-based and environmental educators. The resulting scales are summarised in Table 5. Further focus groups lead to the creation and adaptation of these constructs into the eight scales and 40 items which make up the final PLACES questionnaire.

Data source/evidence:

The questionnaire was created by adapting or modifying scales from four different established learning environment inventories: the Environmental Science Learning Environment Inventory (ESLEI), the "What is Happening in this Class" (WIHIC), the Science Learning Environment Inventory (SLEI) and the Science Outdoor Learning Environment Instrument (SOLEI) developed by Orion et. al. in 1994. In all, a total of eight scales from these questionnaires were used. The scales of Student Cohesion, Integration, and Involvement were taken from the ESLEI (Henderson, 2000). The scales of Teacher Support and Cooperation were taken from the WIHIC questionnaire. The scale of Open-Endedness was taken from the SLEI and the final scale of Environment Interaction was taken from the SOLEI. Both the SLEI and the WIHIC have been used and validated in several large research studies (Fraser, 1998).

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