CHAPTER 4: THE OUTDOOR AS A CENTRAL LEARNING ENVIRONMENT IN THE GLOBAL SCIENCE LITERACY FRAMEWORK: FROM THEORY TO PRACTICE

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1. INTRODUCTION

The Global Science Literacy approach places the concrete environment – the earth systems – in the heart of the learning process. Therefore there is no doubt that any GSL curriculum should emphasize the use of the outdoor as a central learning environment. However, although each year, many classes visit outdoor settings (e.g. science museums, zoos, natural history exhibits, and nature parks), the use of the outdoor learning environment within the formal education system has not fulfilled its educational potential. There is no doubt that logistic limitations, which exist in the school system and lack of adequate teaching/learning materials impact on the teachers' abilities to use the outdoor learning environment. However, the key factor for limiting the use of this learning environment is the ability and the willingness of science teachers to deal with this learning environment. Most teachers are unfamiliar with the philosophy, organization and didactics of field trips and in general they perceive out-of-school visits as an enrichment or/and a social event with vague or limited learning goals (Bringham and Robinson, 1992; Gottfried, 1980; Griffin and Symington, 1997; Orion and Hofstein, 1994; Pontin, 1995).

However, it might be a big mistake to look at the teachers as the main reason for the poor educational outcomes of the out-of-school learning environment. In fact, teachers' lack of understanding of the complexity and educational value of the outdoor environment are due to the followings two reasons: (a) the failure of the science education research community to present clear and coherent answers for the most basic questions, such as why, when, where and how. And (b) the intensive activity of external (informal) education bodies within the formal system that led teachers to perceive the out-of-school as an external learning environment, which is not an integral part of their formal teaching duties.

For example, Thomas and O'Donoghue (1990) noted that one of the primary recommendations of the International Symposium on Fieldwork in the Sciences was "...to develop appropriate pedagogic techniques based on knowledge of how children learn..." (p. 201). It would seem that this neglected state of outdoor education reflects our limited knowledge and understanding of the outdoor as an effective learning environment. For example, McClafferty and Rennie (1992) reviewed 39 studies, published between 1974-1992. These studies neither investigated factors that influence students' ability to learn in an outdoor setting, nor focused on the implementation of field trips as an integral part of the science curriculum. Moreover, most of those studies were conducted in an informal learning context. A more recent example is found in the journal ***Science Education*** (volume 81, issue 6) that was published in 1997 and dedicated to the out-of-school learning. Here again, only a few of the 11 articles included in that special issue dealt with the role of the outdoor learning environment within the formal learning setting and the role of the science teacher in this teaching/learning process.

It should be noted that this review is not intended to be critical. From their point of view these studies have a significant impact on science museums and other external settings. However, they have only limited influence in convincing curriculum developers and science teachers to integrate the outdoor learning environment as an integral component of the classroom learning process. It is suggested that only a systemic, holistic approach might lead to this conceptual change. In order to implement this change teachers should understand the following elements of outdoor learning:

(1) What is an outdoor learning event?

(2) Why go outdoors? (What is the role of the outdoor learning environment in the learning process?)

(3) What is (are) the preferred learning style(s) for the outdoor learning environment?

(4) How should an outdoor learning event be implemented within the learning process?

(5) How can we encourage teachers to use the outdoor learning environment?

In effect, these questions relate to research, development and implementation. Thus, in order to improve the planning and execution of purposeful field trips, research should focus on better understanding of the outdoors as a learning environment. Such was the focus of the author's research in the last ten years (Orion, 1989; Orion, 1993; Orion, 1994; Orion and Hofstein, 1991; Orion and Hofstein, 1994; Orion and Rosenfeld, 1996; Kempa and Orion, 1996; Orion, Hofstein, Tamir and Giddings, 1997). This research together with other important studies (to be mentioned later) are the basis for this paper, whose purpose is to present a practical model for planning and implementing an outdoor learning activity as an integral part of the curriculum.

2. WHAT IS AN OUTDOOR LEARNING EVENT?

A major impediment to progress in the area of out-of-school science trips results from generalizing the outdoor learning environment. Such generalization fails to take into account the bewildering diversity of outdoor settings. Therefore, without a common conceptual framework to distinguish between the many different types of field trips on a systematic basis, the accumulated efforts of researchers, program developers and program implementers alike are in danger of being confounded.

The research literature makes it clear that while science field trips encompass a tremendous variety of different learning experiences, researchers often fail to differentiate between these experiences. For example, summaries of science field trip studies by Koren and Baker (1979) and Mason (1980) lump together outdoor visits together with visits to indoor environments such as museums and factories. In another summary, Sorentino and Bell (1970) defines the term "field trip" even more loosely, i.e., as any organized visit outside of the class to achieve an educational goal. Missing in these three summaries is any attempt to distinguish the important differences between different field trips.

Common sense dictates that distinctions need to be made between different field trip variables, since such differences may well be responsible for different answers to the basic questions posed above. To illustrate this claim, consider the physical factors, which differentiate between the different out-of-school learning environments. These factors might include (a) accessibility to desired resources (low to high), (b) human influence (totally natural surroundings to man-made structures), and (c) weather (degree of rain, sun, humidity and temperature). Consider how each of these factors might differentially affect different out-of-school environments:

(a) Distractions - The term "distractions" can be understood as stimuli, which deflect the learner's attention away from the learning task. In general, there are fewer distractions to a learner in a natural setting than in an indoor setting. For example, in a museum there is a relatively higher density of things to see and these may distract the visitor's attention.

(b) Accessibility to desired resources - Each field trip is connected with a number of desired learning stimuli or resources. In indoor environments, such as museums, the accessibility to these desired resources is high. However, this is not usually the case in natural surroundings; for example, one cannot insure that a particular animal will be observed at a specific time and a specific location.

(c) Weather - The surroundings of each trip can be characterized by such factors as the presence and abundance of rain, sun, humidity and temperature. Clearly, weather is a much more critical factor for field trips in the natural environment than for trips to indoor environments, such as museums.

The outdoor learning environments: The above three parameters enable us to differentiate the physical learning environment into three different types:

- The natural (outdoor) environment. Examples: wilderness and nature areas.
- The semi-natural (indoor/outdoor) environment. Examples: zoos, outdoor science centers, urban surroundings.
- The man-made (indoor) environment. Examples: Natural history museums, science/technology centers and industrial sites.

Figure 1 illustrates only a rudimentary framework since each of the three sub-environments presented above should be differentiated at a more detailed level. For example, although museum and an industrial site are both a man-made (indoor) environments there is a significant difference between them. The same distinctions can be made between a zoo and an urban setting. Moreover, there are major differences among different types of museums and visiting centers. Thus, a description of a physical outdoor environment should also include information such as the learning facilities, the type of interaction with the phenomena under study and the type of the facilitator.

The physical learning environment is only one dimension for defining outdoor learning activities. The other two are the goal context and the duration of time.

The goal context of the outdoor learning environment: The goal context is a crucial factor since there is a great difference between a visit that was defined as a fun/social event and a learning event. In the cognitive aspect there also are two

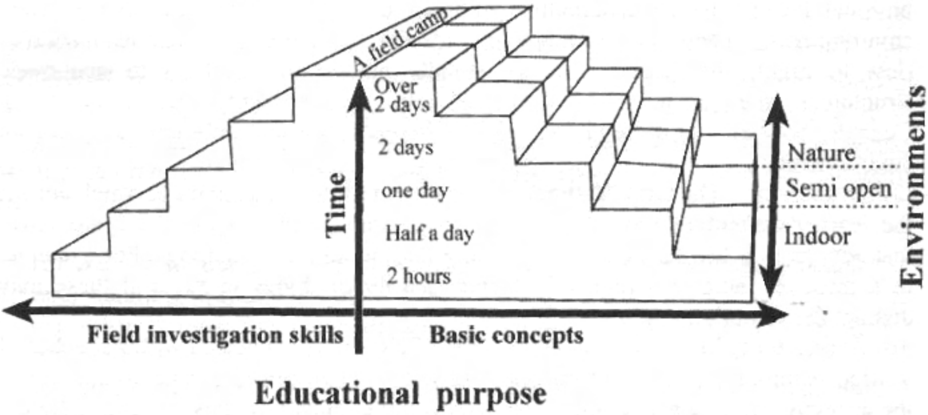

Figure 1: The three dimensional model of identifying a specific outdoor learning event

different objectives in relation to science education: (a) learning of basic concrete concepts through direct interaction with the environment and (b) learning of the field investigation methodology.

Duration of the outdoor learning experience: The amount of time devoted to a field trip greatly influences the preparation of an outdoor event and the type of learning tasks implemented during the event itself. It is possible to distinguish between four types of field trips in relation to the time factor:
a) A short trip of 1-2 hours: Trips of such short duration are usually related to outdoor events that take place in the vicinity of the school. The teacher can integrate this activity easily within the regular studies; the physical environment is well known by the students and the logistic preparation for the event is minimal.
b) A half-day of 4-6 hours: Such trips are usually related to sites such as museums, zoos, science centers, which are not far from the school. However, it requires logistical preparations such as transportation and dealing with the school schedule and preparation of the students for the trip itself (as will be explained later).
c) A whole day of 6-8 hours: Such field trips include visits to natural sites, requiring driving long distances from the school, and sometimes walking for a few kilometers. The preparation for such an outdoor activity is quite complex, since in addition to logistical and educational preparations it requires very careful preparation of the event itself.
d) Two or more days: This usually involves a field camp. This, of course, is the most complex event in terms of preparation and operation. However, it enables the class to deal with more investigative type of learning and to overcome geographical and psychological novelties (as will be explained later).

The above three factors: physical environment, educational goal and duration enable us to define the outdoor learning environment to a three factor model as illustrated in Figure 1. Each box in this model defines a specific outdoor learning event. There is no doubt that there are some similarities among all the different outdoor learning environments. However, it is also likely that each outdoor environment has unique characteristics which curriculum developers and teachers should consider.

3. WHY GO OUTDOORS? (WHAT IS THE ROLE OF THE OUTDOOR ENVIRONMENT IN THE LEARNING PROCESS?)

The "resources invested" in taking a class outdoors are very high in terms of organization, economic, logistics and safety. Therefore, the "educational payoff" should be very high as well. It is suggested that the gap that exists between the high "resources invested" and the generally lower "educational payoff" is equal to the gap that exists between the high potential of the outdoor learning environment and its relatively limited fulfillment. This imbalance might be corrected only through a very clear definition of the unique educational contribution of the outdoor learning environment.

A literature review of any science education journal, within the last three decades, reveals that research concerning the outdoors as a learning environment is located at the periphery of mainstream research. This observation is quite surprising since the role of the out-of-school learning environment is rooted deeply in the philosophy and psychology of education. Important scholars beginning with Rousseau through Dewey, Piaget, and Ausubel have direct and indirect contributions towards promoting the outdoor as an essential learning environment. Although currently, constructivism - a child-centered paradigm - dominates the field of science education, nonetheless, it is hard to understand why so little effort is invested in introducing the out-of-school real concrete world as an available learning environment for teachers and students.

A gap of two centuries and essential differences separate the educational philosophies of Rousseau and Dewey. However, they both can be perceived as the founders of a child-centered philosophy since they believed in children's natural curiosity and the meaningful learning that can grow from it. Rousseau, who believed in spontaneous learning, claimed that children should learn from their direct experiences and not just from books (Egan, 1992). Dewey as well claimed that educators should often use the physical and social outdoor environments as an integral part of the learning process (Rillo, 1982).

Although there is a long-term debate concerning the meaning of "spontaneous learning", there are no arguments concerning the existence of a "natural learning". No one can argue against the fact that young children accumulate huge reserves of very complex knowledge and cognitive understandings before entering kindergarten. Another well-known phenomenon is that there exist children in the markets of third world big cities who although they never attended school, can conduct very complicated mathematical accounts that counterparts in school cannot perform. Another place where it is still possible to observe natural learning processes is in some areas of Africa and South America where learning and teaching is a daily occurrence amongst the parents and children of primitive tribes.

One way to analyze such natural learning processes is through the following five characteristics: Location of learning; type of learning experiences; relevancy; role of verbal communication; and the subject of learning. Table 1 presents the two edge components of the natural – non-natural learning dimension.

Table 1: Characteristics of the natural vs. non-natural learning dimension.

Characteristics		**Natural learning**		**Non-natural learning**
Location		Takes place in a relevant setting to the learnt subject.		Takes place in a closed space that has no relation to any learnt subject.
Type of experience		Includes a concrete experiencing with the subject to be learnt.		Only rarely includes real-life concrete experiences with the subject to be learnt.
Relevancy		The subject to be learnt is highly related to the learner's relevant world.		No immediate relation between the subject to be learnt and learners' relevant world.
Verbal communication		The concrete experience is mediated by verbal communication.		Verbal communication replaces the experience through description of imaginative situations.
Subjects		Learning is idiosyncratic. Rate of progress depends on the learner.		The subject of learning is a large group. It is very difficult to adjust the learning for individuals.

If one would try to locate the schools' ordinary learning today on the scale presented in Table 1, there is no doubt that it would be much closer to the non-natural end than the natural learning end. Moreover, it might explain why so many adolescents all over the world do not like schools--because the common way of teaching in school is the antithesis of their natural way of learning.

Based on the characteristics of natural learning it is suggested that the use of the outdoor learning environment might transform school learning into a more natural process for many children. Having stated this, one should be very careful not to cross the line between pedagogy and demagogy, since there is no way to teach abstract concepts such as the particle model, or the structure and function of cells through the characteristics of natural learning. However, in parallel to the many abstract concepts that any 21st century child of the developed world should know, there are still many concrete scientific concepts and skills that can be learnt in the out-of-school world. As already noted by Orion and Hofstein (1994), Kempa and Orion (1996), Kali, Orion and Eylon (2003) and Dodick and Orion (2003), even very abstract concepts such as the rock cycle and deep time can be internalized if their study includes the concrete component of the outdoor learning environment.

4. THE PREFERRED LEARNING STYLE (S) FOR THE OUTDOOR LEARNING ENVIRONMENT?

I suggest that the main cognitive contribution of the outdoor learning environment is in the concretization aspect that while conducted properly might make the learning process more natural for many students.

The literature provides convincing evidence that outdoor learning activities are beneficial, especially when the teacher combines concrete learning experiences (as an intermediate step) with higher levels of cognitive learning experiences (Vinci, 1969, Folkomer, 1981; MacKenzie and White, 1982). Novak (1976) in describing the implementation of Ausubel's learning theory (Ausubel, 1968) in biology education, points out the need for concrete experiences as a transitional learning stage from primary concepts to secondary concepts. This idea is similar to the "hands-on experiences" which Piaget (1970) identified as very helpful aids for the transition from a concrete to a more abstract level of cognition. The literature suggests two groups of concepts that could be taught on field trips: a) primary concepts derived through sensory-motor experiences and b) phenomena-related concepts which could act as concrete "subsumers" for further learning in the classroom.

Based on Piaget and other developmental psychologists, Lesgold (1998) includes the "concrete vs. abstract knowledge" as one of the basic representation forms of knowledge. However, he claims that for many concepts this difference is not clear since they include both concrete and abstract components. This notion is very important for our ability to use the outdoor learning environment as a key stage for the development of abstract knowledge as well. What we must do is to analyze such concepts for their concrete and more abstract components. Then we should analyze the concrete components to those that might be made concrete through classroom/laboratory activities and those that can be made concrete only in the outdoor learning environment.

Orion (1993) suggested that the main role of the science outdoor activity in the learning process is to provide direct experiences with concrete phenomena and materials. The unique element of the outdoor experience is not in the concrete experiences themselves (which could also be provided in the laboratory and classroom), but the type of experiences. Students could view slides of a dune and investigate quartz grains in the laboratory, but it is only by climbing the steep front slope of a sand dune, that a student could receive a direct sensory-motor experience of learning about the structure of a dune. Experiential (hands on) activities can facilitate the construction of abstract concepts and can serve as subsumers that enhance meaningful learning which provide the framework for long-term memory retention.

Historically, the interactionist view concerning the cognitive contribution of the interaction with the physical environment was suggested by few educators (e.g. Dewey 1896; Lashley 1951) in opposition to the stimulus-response view of behavior. However, only Gibson (1966) developed a systemic theory of direct perception. Gibson argued that perception should be understood as a process of picking up information as an aspect of the agent's activity, rather than as a (passive) process of constructing representations of the situation and operating on those representations (Greeno, Collins and Resnick, 1996). The findings of Mackenzie and White (1982) support this theory. In this study three groups that studied the same subjects with the same teacher were compared. The control group studied in the classroom only, while the two experimental groups also experienced field trips. One experimental group used a content-oriented approach while the other group adopted a process-oriented approach. The study found that the knowledge acquisition and long- term memory of the group of "process-oriented" students was significantly better than the others. However, no significant difference was found between the "content-oriented" and the "classroom" groups. These findings support two significant conclusions. First, outdoor educational events in themselves do not guarantee higher cognitive gains. Second, realizing the maximum educational impact of a field trip depends upon the optimal use of concrete interactions between students and the environment. In summary, following the psychological theories and the practical findings presented here, it is suggested that a process-oriented, rather than a content-oriented approach is the preferable learning strategy in outdoor learning activities. The process approach focuses on the interaction between the student and the environment; students actively construct information from the environment, rather than passively absorbing information from teachers.

I assume that some of the readers might think that this conclusion is almost trivial. However, anyone with experience with those bodies and individuals who conduct outdoor learning know that this conclusion is not trivial at all. Although some progress can be observed, the effect of the constructivist movement is still quite limited amongst many museum and field leaders who still espouse the classical content-oriented approach.

5. HOW SHOULD AN OUTDOOR LEARNING EVENT BE IMPLEMENTED WITHIN THE LEARNING PROCESS?

Falk, Martin and Balling (1978) and Falk and Balling (1982) note that the ability of students to carry out assignments during a field trip is related to the novelty of the field trip setting. They found that if a setting was novel, students had to explore it and only after becoming familiar with it, could they concentrate on their assignments. Orion & Hofstein (1994) expanded the idea of the field trip setting's novelty by identifying three novelty factors, which constitute a "novelty space". They suggested that the novelty space of an outdoor environment consists of three factors (Fig. 2):

1. the cognitive novelty - previous knowledge concerning learning goals;
2. the geographical novelty - previous experience concerning the specific physical environment;
3. the psychological novelty - previous experience based on the students learning experience.

The cognitive novelty depends on the concepts and skills that students are asked to deal with throughout the outdoor learning experience. The geographical novelty reflects the acquaintance of the students with the outdoor physical area. The psychological novelty is the gap between the students' expectations and the reality that they face during the outdoor learning event. The psychological novelty of the population in that research reflected their previous experiences in field trips as social events, rather than learning activities.

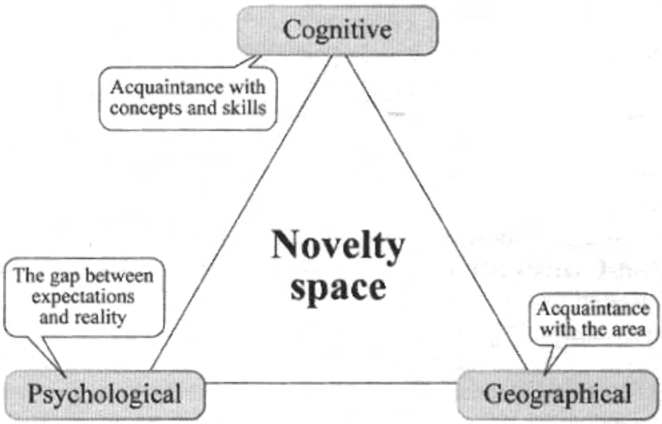

Figure 2: The three dimensions, which identify the novelty space of an outdoor learning activity

The novelty space concept has a very clear implication on planning and conducting outdoor learning experiences. It defines the specific preparation required for an educational field trip. Preparation directly concerned with the three novelty factors can reduce the novelty space to a minimum and thus facilitate meaningful learning during a field trip. The cognitive novelty can be directly reduced by several concrete activities. For example, working with the materials that students will meet in the field, as well as simulation of phenomena and processes through laboratory experiments. The geographic and psychological novelties can also be reduced indirectly in the classroom, first by slides, films and working with maps, and second by detailed information about the event: purpose, learning method, number of learning stations, length of time, expected weather conditions, expected difficulties along the route, etc.

While it is not possible to fully prepare students for a specific outdoor learning event, identifying the specific novelty space of the class involved, and then adapting the level and the length of the learning activity during the field trip, could lead to improvement in the educational value of the outdoor experience.

Orion & Hofstein (1994) argued that in general an outdoor learning activity should be placed early in the concrete part of the learning process, and should be mainly focused on concrete interaction between the students and the environment. The field trip together with the preparatory unit can constitute an independent module, which might serve as a concrete bridge towards more abstract learning levels. Thus, a field trip should be planned as an integral part of the curriculum rather than as an isolated activity (Figure 3).

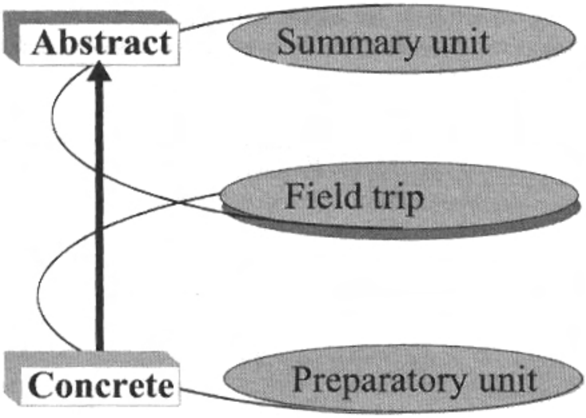

Figure 3: The spiral model of integrating an outdoor learning activity within the indoors-learning process.

6. HOW CAN WE ENCOURAGE THE USE OF THE OUTDOORS AS A LEARNING ENVIRONMENT?

If one accepts that the outdoor learning environment has a central role in the learning process and consequently that it should be an integral part of the learning process, then the teacher must also be an integral part of the outdoor learning activity. However, as already mentioned, teachers (both in the sciences and humanities) all over the world do not perceive the outdoors as a formal learning environment. The common view among teachers is that outdoor events provide social contributions and should be included as enrichment and not as an integral part of the learning process.

Thus, any attempt to increase the profile of the outdoor learning environment within the educational system should involve a major conceptual change or even revolution concerning the teachers' perception of the outdoors as a learning environment. Teachers should be provided through both pre-service and in-service programs with tools to address the questions, which were posed in the beginning of this article such as: WHAT is the outdoor learning environment? WHY use this learning environment? HOW do we use it? Moreover, teachers should be given the tools necessary to conduct the following educational activities: (a) to identify concepts which might be best learnt through a concrete interaction with the environment; (b) to develop concrete outdoor learning activities; and (c) to integrate outdoor learning activities with the learning processes which take place in other environments such as the classroom, laboratory and computer.

In service training projects for teachers should also focus on an educational mapping of the school's immediate surroundings to locate outdoor learning sites. However, changing teachers' attitudes towards outdoor learning environments is a major conceptual change, which might be achieved only through a simultaneous systemic treatment. In other words, such treatment should embrace all the components of the educational system including policy makers; inspectors; principals; the curriculum wing; the in-service and pre-service training departments; the educational administration wing; the evaluation department; the different grade levels of schools (i.e. kindergarten, elementary and secondary); and the regional school branches. All of these components should contribute the atmosphere and the motivation for the teachers to change their attitudes towards the outdoors as a learning environment and of course, to provide them with the needed resources to implement this new and complex teaching strategy.

It is unlikely a Ministry of Education (such as in Israel) on its own will initiate such a reform. The only force, which might prod educational policy towards this goal is the science education research community. Thus, the low profile of the outdoors as a learning environment is a result of a vicious cycle, which begins with the limited research that has been directed towards this area of inquiry by education researchers and ends with the fact that there is a lack of concrete support of the research community that might kick-start such reforms.

Finally, it is crucial to determine the influence of informal bodies such as museums, science centers and field centers on the profile of outdoor teaching, and what should be their role so that this situation may change. During the last 15 years I have conducted a systematic study of such external informal bodies and guides. This study encompassed over 100 naturalistic observations of informal learning activities and hundreds of interviews with teachers, students and museums and field leaders concerning the relationships between an out-of-school informal learning event and the formal science learning in schools. This study was mainly conducted in Israel but also includes a similar but quite limited study in USA, UK, France and Australia. This long-term and broad scale study indicates that there are very similar type of relationships between external informal learning bodies and formal education all over the world. Recently there has been some movement of informal science education towards the formal system. Informal centers all over the world have begun to understand that in order to conduct meaningful visits for students they have to adjust their programs according to the science curricula of the visiting classes and work collaboratively with the schoolteachers.

However, this movement is still quite limited and there are still many traditional informal bodies that are quite disconnected from the reality of schools, their aims and curriculum. This parallelism has a crucial negative influence on both teachers and students. Unknown environments and situations intimidate any human, especially teachers, who have become accustomed towards controlling the learning situation and teaching environments. For them such novelty creates a hostile environment, which makes it difficult to function. Unfortunately, education departments of many (but not all) informal bodies focus on the development of local guides and programs which might replace the teachers. Surprisingly, teachers accept this situation and as a result they are divorced from this type of learning activity. Since the teachers are usually not involved with the informal programs, such programs are not related to the school's science learning. Consequently, the teachers and the students do not perceive the outdoor learning environment as an integral part of the formal learning and thus another viscous cycle starts.

This viscous cycle creates a sad situation in which even if students experience a meaningful and/or an enjoyable learning event in the outdoor environment they do not connect it with the enjoyment of learning. The most common answer to the following question (which I asked hundreds of students): "Did you enjoy the outdoor event and why?" is "Yes, I enjoyed it a lot because we had a day off". This perception also emerges from the most common statement that teachers say to their students before going outdoors: "If you don't behave then we won't go on the field trip next week…" Such a statement means that the outdoor event is not an integral part of learning, since students usually do not hear statements such as: "If you won't behave well …we won't go to the laboratory or I won't give you homework."

Informal guides reflect the same attitude. A very common statement of guides that I noticed during my observation of school visits to an outdoor setting is: "Hi, this is not the school; we intend to have a lot of fun here…" The following quote is from an interview with a field leader: "I feel quite insulted when they (the students) call me 'teacher'. I immediately ask them to call me 'guide' or by my first name, but not 'teacher'". This quotation represents a common view that emerged from interviews that were conducted with over 100 informal guides.

In 1995 a new research strand "Informal learning" was established within the National Association for Research in Science Teaching (NARST) of USA. From the year that it was established, this group rejected the suggestion (raised each year during the annual meetings) to change the title of this group, because it contributes to the negative connotations as explained above.

It is rather odd that the same group which promotes the understanding that learning can take place anywhere at anytime also promotes the distinction between informal and formal education. Unfortunately, this perception pushes the teachers out of the outdoor learning process and perpetuates the perception that learning is something (usually) boring that one does in school while an outdoor activity is fun partly because it is not connected with the school learning.

In order to stop this vicious cycle the informal bodies should focus on providing in-service training programs for teachers to teach them how to independently use the outdoors as a learning resource. Such programs will also assist them to integrate learning in school with the resources of a specific outdoor setting.

7. SUMMARY

The outdoor environment to a large degree is a wasted learning and teaching resource. Educational systems around the world fail to fulfill the high cognitive potential of the outdoor learning environment. The science education research literature demonstrates that there are solid reasons for using this environment in the learning process. Furthermore, it also includes practical models for integrating the outdoor as an integral learning environment within the regular science curricula. However, such knowledge is shared by a relatively small number of science educators. In order to upgrade the status of the outdoor learning environment so that it is comparable to the lab and computer environments, science teachers should first undergo a deep conceptual change concerning their attitudes towards the outdoors as a learning environment. Following such conceptual change, massive in-service and pre-service programs should be provided to science teachers so that they can build the teaching skills needed for using the outdoors properly. In addition a massive curriculum development effort is also required.

Such large-scale reform has a limited chance of success unless it encompasses all the facets of the educational system. However, the motivation for an educational system to start such a large costly process is highly dependent on the support of the science education research establishment.

Another key factor influencing the science teachers' ability to use the outdoor learning environment is the informal education establishment. There is a strong need to close the gap between the informal and formal education so that they become an integrated system. Following this new insight there should be a stronger effort at transforming outdoor sites into friendly and available teaching resources - an immediate extension of the laboratory and the classroom learning environments.

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