GLOBE Program and Students' Empowerment

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Dedication

I dedicate this project

To my husband, Salim, who *is the one I will always accept, forgive, appreciate, and love unconditionally.*

To my sister, Rima, who is my mentor and my role model in life

To my sister, Sawsan, who is my great advisor

To my sister, Mona, who is my real support in life

To my son, Akram, who is the closest to my heart and soul

To my daughter, Aline, who gave my life more meaning

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Abstract

The purpose of the project in hand was to explore the effect of the GLOBE Program on empowering students through constructivist learning and teaching. This case study was conducted in two schools in Lebanon to examine students' empowerment in relation to the GLOBE Program. It addresses the issue of empowerment by integrating theory and practice. The project attempted mainly to model how the empowerment process takes place in the two Lebanese selected schools. Participants were two teachers from two different schools, the GLOBE coordinator in Lebanon, and six students. Data were collected mainly from interviews, observation checklists, and document analysis. Results showed that both schools encourage the implementation of GLOBE Program and consider the Program a constructivist tool to empower students on the academic and social levels. Additionally, the results showed the impact of GLOBE on developing students' leadership skills that would enhance students' abilities to become autonomous learners.

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Introduction

1.1 Context of the Study

We live in a changing planet. Day after day and moment after moment several changes are taking place. All of us want to understand these changes and to explore their causes. As a matter of fact, the destructive natural factors and the socioeconomic factors are not the only source of danger threatening human life. Studies indicate that the quality of life on earth is deteriorating due to human abuse of the natural and raw resources of the core of the earth. Thus, a strong working alliance with new generations is needed to understand the detrimental effects of losing the non- renewable natural resources. As a result, the Global Learning and Observation to Benefiting the Environment, GLOBE Program, was established aiming at rebuilding the bond between nature and people. This Program is a hands-on international environmental science and education program.

GLOBE has trained around thirty -six thousand teachers from 18000 schools over the world. In Lebanon, the Association for Forests Development and Conservation (AFDC) is running the Program since 1998 in cooperation with the Ministry of Environment and Cisco Systems. Thirty-five schools are participating in GLOBE from different Lebanese areas (refer to appendix A). The goals of GLOBE are to raise environmental awareness and to contribute to the scientific understanding of the earth.

NASA Ames Research Center, 2004 asserts that the Program has great potentials in promoting inquiry learning; it facilitates the study of science using inquiry processes. At a more global level, this program fosters the creation of a worldwide research team of students, teachers, and scientists for the purpose of exchanging and generating knowledge about the earth.

Students will have the opportunity to do science and therefore become actively involved in their own learning (NASA Ames Research Center, 2004). They will learn in the context in which knowledge is to be used. In comparing The GLOBE Program with the constructivist approach, it is noticed that they are compatible in a sense that they both emphasize the active search for knowledge or understanding to satisfy curiosity. According to Chin and Chia (2004), science programs should help students answer ill defined questions. A study was conducted by Bou Jaoude as cited by Abd- El-Khalick, et al .(2004) to see the balance among the scientific themes in the new Lebanese curriculum and to check whether the science curricula are preparing scientifically literate citizens. Four aspects of scientific literacy used by Chiapetta et al. as cited by Bou Jaoude guided this study: Knowledge of science (aspect 1), investigative nature of science (aspect 2), science as a way of thinking (aspect 3), and interaction of science technology with society (aspect 4). Bou Jaoude revealed that students fail to see the connection and to retrieve the knowledge they obtain in science classes. This leads to the emphasis on aspect 4 of the curriculum that stressed on moving the curriculum from an academic exercise to a real implication in students' real lives. This study about the GLOBE Program comes in response to helping students see the connection between science they tackle in books and their surrounding. The importance of GLOBE Program lies in its ability to stimulate the four aspects of the Lebanese curriculum in science. Besides, Bou Jaoude as cited in Abd- El-Khalick, et al. (2004) explained that the Lebanese curriculum emphasizes aspects 1, 2, and 4 and neglect aspect 3 that focuses on thinking and construction of scientific knowledge. However, GLOBE main goal is to help students construct their own knowledge and understanding about the globe surrounding them (NASA Ames Research Center, 2004).

This project explores the effect of the GLOBE Program on empowering students. Interviews, observations, and document analysis are used to measure the degree of students' empowerment at the end of the integration of GLOBE Protocols in some units in the science curriculum.

1.2 Purpose of the Study and Research Statement

The purpose of this study is to investigate the relationship between the constructivist educational approach applied in the science curriculum through the Global Learning and Observation to Benefit the Environment (GLOBE Program) and students' empowerment. More specifically, the purpose is:

- Assessing the integration of the GLOBE Program within the science curriculum in the Lebanese Schools.
- Assessing the training programs provided by the GLOBE team to Lebanese teachers.

1.3 Operational Definitions

GLOBE Program

GLOBE is a program with a mission to support the scientific community by creating, conducting, and coordinating projects (NASA Ames Research Center, 2004). GLOBE highly encourages students to utilize "global measurements" to help answer questions about how the environment around them is affected (Refer to appendix B). Through investigation projects, students learn how to create their own hypotheses, analyze data, draw conclusions, and report their results. These projects aim at extending students' responsibility and ownership by supporting them to determine what they need to learn and how they can learn it.

NASA Ames Research Center (2004) presents a set of GLOBE protocols that aim to involve students in:

1. Investigating earth as interrelated systems
2. Applying science rather than studying science
3. Working on hands-on and minds-on activities
4. Collecting data about the earth using the GLOBE kit tools

Integration in the Science Curriculum

1. Using this program as a complement to the science curriculum.
2. Using some of the GLOBE Protocols in specific units in science curriculum for grade six (units on water resources, trees, land cover, soil, and weather).

Meaning of Constructivist Learning

Constructivist learning is to be defined in this study as a learning approach that is guided by a number of principles including the following:

1. Learning is an active and social process in which the learner constructs new knowledge rather than acquires information (Shor, 1992).
2. New learning builds on previously acquired knowledge and as the learner elaborates upon and interprets the information, initial ideas are reshaped (Parsons, 2003)
3. Learning occurs most effectively when it is situated in experiences that are authentic and meaningful to the learner (Fortus, Krajcik, Dershmir, Marx, & Mamlok, 2004).

Meaning of Constructivist Teaching

In this study constructivist teaching is meant according to the following indicators:

1. Teachers allow students' responses to drive lessons, shift instructional strategies, and alter content according to students' learning needs.
2. Teachers encourage and accept student autonomy and initiative
3. Teachers' professional development guides the lessons rather than the textbooks and workbooks (Howe & Jones, 1993).
4. Teachers nurture students' natural curiosity.
5. Teachers engage students in experiences that might engender contradictions to their initial conjectures and then encourage discussion (Maurer, 1998).

Students' Empowerment

This study adopts Courtland's definition of empowerment as an internal developmental process in which a person works on discovering the way power operates in his or her life to take reasonable steps to control personal power and to channel it in constructive ways (Courtland, 2005). The focus in this study is how the GLOBE Program empowers students both socially and academically. Social empowerment is the ability of students to develop self-confidence, ability to speak in public, and communicating with people (Wade, 1997). Academic empowerment is the ability of students to excel in scientific material (Robinson, 1994).

Professional Development of Teachers

In the context of this study, professional development is related to in-service teacher education in constructivist principles and practices and in the GLOBE Program. Professional training includes teachers attending workshops and seminars inside and outside the school (Fiszer, 2004). According to AFDC unpublished archive 2004, teachers' professional development is needed in the implementation of the GLOBE Program since teachers are the main actors to assure its success. Teachers need to develop intrinsic motivation for the Program to be able to guide the students in their search for knowledge. This kind of motivation can be reached through increasing teachers' awareness of the benefits of GLOBE Program and of their role as the main facilitators of the Program.

1.4 Rationale and Significance of Study

The GLOBE Program has been developed in response to the call for increasing scientific literacy in schools and in the community (NASA Ames Research Center, 2004). The rationale of the study at hand is to stress the importance of encouraging students to construct their own knowledge in context related to the environment. Although many studies have tackled issues on the constructivist approach for building scientific literacy, yet few research studies provided methods or techniques for effective application in schools.

Besides, it is noticed that the use of GLOBE Program is limited in Lebanon. According to AFDC archive, many Lebanese schools were invited to a set of workshops about the GLOBE Program, yet only eight schools are actively participating or implementing the GLOBE Program. Therefore, more research should be conducted in Lebanon to assess the implementation of such a program, to investigate the obstacles hindering its implementation, and the role it may play in empowering students. Moreover, it is expected that this study will provide insight on the state of teachers' professional development for the success of such a program through active involvement and participation.

Literature Review

This review of literature defines the GLOBE Program, discusses the protocols of GLOBE and the way they relate to constructivist learning and teaching. In addition, the literature describes the connection between the GLOBE Program and students' empowerment in science.

2.1 Constructivism

Constructivism is a movement that has grown largely as a reaction to the excessive emphasis on rote memorization and miming in the process of education (Brooks & Brooks, 1999). Wilson (1996) argues that having learned something in the school does not guarantee that one would use the acquired knowledge in new contexts or in his/her real environment. This led to the development of the constructivist approach that stands in contrast to the deeply rooted ways of teaching and learning. According to Brooks and Brooks (1999), constructivism emphasizes encouraging students to construct their own knowledge through providing them with an appropriate learning environment.

Constructivism, as a way of coming to know one's world, is supported by a large and honorable body of literature and research. The most influential proponent theorists are Piaget, Bruner, and Vygotsky. Piaget views constructivism as a way of explaining how people come to know about their world (Piaget as cited in Brooks & Brooks, 1999). He views the human mind as a set of cognitive structures that help us make sense of what we perceive, by which we gain more experience. Vygotsky (as cited in Chin & Chia, 2004), believes that individuals construct knowledge only when they engage socially in talks and activities about shared problems or tasks. Additionally, Fortus, Krajcik, Dershimer, Marx, and Mamlok (2005) add that the social constructivist theory sees learning as an active and continuous process in which learners use their prior knowledge to construct and adapt meaning of the new knowledge obtained. Therefore, a constructivist learning environment must be provided wherein students are given room to explore (Maurer, 1998). It is to provide learners with the opportunity to work collaboratively, take actions, and make decisions.

According to Honebein (2005), the constructivist learning has three basic goals that enhance students' basic science process skills. The first goal is expanding students' responsibility and empowering them by giving them ownership to determine what they need to learn and by encouraging them to manage their own learning activities. The second goal is to situate learning in a meaningful context that aids students to apply the learned information. The third goal is to engage students in a high and dynamic level of construction of their own knowledge (Driver et al., as cited by Chin & Chia, 2004) by designing authentic learning situations and by promoting higher order thinking skills.

According to Duckworth (as cited in Brooks, 2000), students are invited through constructivism to experience the world's richness, ask their own questions, seek their own answers, thus challenging them to understand the world's complexities. Furthermore, Zion, et al. (2004) emphasize the fact that the constructivist approach encourages students to revisit content and problems from different perspectives and to promote students' articulation and presentation of ideas, perspectives, strategies, solutions, and creations. Additionally, in constructivist classrooms, teachers search for students' understanding of concepts, and then structure opportunities for students to refine these understandings by posing contradictions, presenting new ideas, asking questions, encouraging research, and engaging students in inquiries (Brooks, & Brooks, 1999). Brooks and Brooks (1999) present five main principles for an effective constructivist classroom:

1. Teachers seek and value their students' points of view.
2. Classroom activities challenge students' suppositions. Students are viewed as thinkers of emerging theories about the world.
3. Teachers pose problems of emerging relevance to foster the creation of personal meaning.
4. Teachers structure lessons on primary concepts and big ideas, since students are more engaged if ideas are presented holistically.
5. Teachers assess students' learning in the context of daily teaching.
6. Students work primarily in groups.

Howe and Jones (1993) assert that knowledge is not transmitted from one knower to another, but it is actively developed by the students who are responsible for their own learning and thinking. Ogens (as cited in Zion et al., 2004) found that even though students may enjoy lab and field activities, they may not develop positive attitudes toward science. Chin and Chia (2004) have shown that school science has traditionally been built around well-defined problems, and did not give students the opportunity to tackle real life problems (Frederiksen et al., as cited by Fortus et al., 2004). For this reason a number of science programs have been developed that stress constructivism and inquiry learning. In fact, Blumenfield, Marx, Soloway, and Krajcik (as cited in Fortus, et al., 2005) found that some characteristics are to be found in such programs like being centered on authentic knowledge, allowing students to construct their own knowledge, and viewing teachers as facilitators and learners along with students rather than knowledge providers. Zion et al., (2004) present the first program, BioMind, designed by a group of thirty biology teachers to enhance students' inquiry skills such as self-direction, personal initiative, higher- order thinking, and team work. Another program was developed by Kafai and Chings (as cited by Fortus et al., 2005). In this later program, students were responsible for selecting their own research questions in implementing neuroscience in software and for managing their projects during the whole process.

A study was conducted by Fortus et al. (2005) to describe a Design-Based Science Program and its impact on students' scientific knowledge. The participants were 92 students. The findings of this study show a high correlation between constructivist learning and students' scientific understanding, since the students were able to apply the scientific skills (observation, classification, analysis, and relating objects) in real life environment. This learning experience enabled students to deal with real-world and ill-defined problems with more ease and become able to apply this constructed knowledge in new contexts. Literature has supported this proposition, since Wason and Laird (as cited in Fortus et al., 2005) emphasized the fact that learning can be improved when abstract arguments are embodied in contexts significant to learners. The constructivist approach is a vital need for the development of scientific literacy in schools and in the community. According to Black (2004), implementing this approach will encourage students to reason their way instead of being spoon-fed. They will develop the ability to summarize, elaborate on concepts and ideas, relate topics to their own knowledge, and make connections between related concepts.

Previous research has shown that school science has traditionally been built around well-defined problems, and did not give students the opportunity to tackle real life problems (Frederiksen, et al., as cited by Chin & Chia, 2004). For this reason a number of science programs has been developed that stress constructivism and inquiry learning. One of these programs is the GLOBE Program.

2.2 GLOBE Program

The GLOBE Program is a hands-on international environmental science and education program. GLOBE goals are to enhance environmental awareness and to contribute to the scientific understanding of the earth. As a matter of fact, the GLOBE Program has great potential in promoting inquiry learning; it facilitates the study of science using inquiry process (NASA Ames Research Center, 2004). GLOBE improves students' understanding of science because it involves them in performing real science, including taking measurements, analyzing data, and participating in research in collaboration with scientists. GLOBE students contribute data for scientists to use in their research. This program is a combined package of protocols and learning activities about the atmosphere, the soil, the land cover, and water. The protocols focus on data collection and data reporting, and broaden to include other parts of inquiry processes such as formulating hypotheses, analyzing data, and drawing conclusions. The students participating in GLOBE have the opportunity to carry out a series of investigations that scientists have designed to gather data about the earth (refer to appendix B & C). Moreover, Students will develop the ability to form connections between the science they encounter in their textbooks and the authentic science that is required for solving real life problems.

The GLOBE Program is considered to be a tool that can be used to encourage active, self-directed, learner-centered, and collaborative experiences; all of which support constructivist-learning principles (NASA Ames Research Center, 2004). It is to mediate between students' world and the world of science, by increasing the possibilities of transforming the classroom into an active learning environment where there is a dynamic interplay of questioning, explanation, argumentation, investigations, and communication of ideas and findings this meets with Lapan, Kardash, and Turner (2002) who argued that effective learning and knowledge construction involve the cognitive processes of selecting, organizing, and integrating information.

The GLOBE Program is compatible with the constructivist approach in a sense that they both emphasize the active search for knowledge or understanding to satisfy curiosity. In addition, both call for tackling real tasks, build upon students' collaboration, and consider the teacher as a facilitator who encourages students to explore using their senses and their critical thinking skills. In this sense the GLOBE Program coincides with Hierbet, Gallimore, and Stigler (as cited by Judi, et al., 2003) who explained the need for a significant change in the culture of science teaching and its curricular knowledge to enable students to engage in their own learning and develop a sense of ownership.

2.3 Students' Empowerment

The concept of empowerment has its history in early work on participative decision-making (Short & Greer, 1994). There are many definitions in literature for the word "student empowerment". In this study, the definition of empowerment will be limited to the idea that empowerment involves processes and outcomes, whereby students gain greater access to, and control over resources and their lives. Students then become actively involved in exerting an influence (Rappaport, as cited by Parsons, 2003). Empowering processes are series of experiences that help individuals become more aware of their goals and of the ways to achieve them. Empowerment in this context is related to empowering students both academically and socially. According to Claus and Ogden 1999, to become an integrated person is not only to understand the world in which we live and work, but to become the kind of person who will take part in shaping and reshaping this world. Haynes and Gwendolyn (1996) argue that, through empowerment, students will have a shared authority with their teachers. It is a situation that enables students to see themselves as subjects and agents involved in the construction of reality, rather than as objects or pawns enslaved to a pre-existing reality defined by others. Empowerment is possible only when students will no longer assume the passive role of "object" and the teacher the active role of "subject." Students will be considered as entities empowered to exert influence upon the surroundings. Thus, students will enjoy ownership of the classroom experience via their participation in shared authority; additionally they will monitor their own actions (Lapan, Kardash, & Turner, 2002).

Empowerment in the context of this study is an internal developmental process in which a person discovers how power operates in his or her life and then takes reasonable steps to seize personal power and channel it in constructive ways (Courtland, 2005). Students become the shapers of their learning instead of being passive recipients. Furthermore, students of diverse backgrounds, interests, and abilities have a chance to succeed as they become central in the process of molding and forming the activities and results of classroom learning. Haynes and Gwendolyn (1996) emphasize that the purpose of education is "not to transfer knowledge but to create environments and experiences that bring students to discover and construct knowledge for themselves." According to Wade (1997), artificial formats make students miss the opportunities to discover how to define problems and how to determine what tools to use as part of the solution to a problem.

In the GLOBE Program students are provided with principles and competencies that they can apply to new situations in the changing world. Claus and Ogden, 1999 mention five main principles for empowering education. These five principles are situated learning, dialogue discourse, teachers as problem posers, critical thoughts, and activist learning. As a matter of fact, the GLOBE is consistent with these principles since its activities provide situated learning, which means learning that is rooted in the lives, interests, and concerns of the students. Claus and Ogden (1999) argue that this kind of learning makes the learning experience more meaningful and motivating than the traditional teacher-centered model. The GLOBE also agrees with the concept of dialogic discourse, which means engaging students in democratic and participatory process in which group discussion is central (Wade, 1997). Additionally, this program engages students in self-regulated learning that will enhance their academic achievement. Moreover, students will develop the skills of answering critical questions that are posed by teachers (NASA Ames Research Center, 2004). These critical questions may engage students in analyzing and rethinking the major changes that are taking place in the environment (Lapan, Hardash, & Turner, 2002). According to Shor (1992), this approach of learning makes students become change- agent in a sense that they learn and act for the transformation of self and society.

Macrorie (as cited by Bowen, 2001) proposes a process approach to research called the I-Search (refer to appendix D). The personal nature of an "I-Search" motivates students because they will be searching for something they want to explore further. The process approach aligns with the constructivist philosophy and accommodates students' different learning styles. The choices students can make with an I-Search give them a feeling of ownership and empowerment. Students have the opportunity to learn a process for doing research that can be used for a life time. Current research stresses the importance of assisting students to believe in themselves. According to Stone (1995), in conceptualizing the notion of shared authority, the teacher must decide when to direct and when to follow, when to intervene and when to step back, when to speak and when to listen. In shared authority, teachers work to raise students' awareness of their duties and encourage them to be accountable for fulfilling those duties, and to consider themselves as entities empowered to exert influence upon the surroundings.

Students have to learn and experience hands-on science since they are natural born scientists, connect science to their knowledge and concrete experiences, and feel empowered by the usefulness of science (Martin, Sigur, & Schmid, 2005). Therefore, through the GLOBE Program, students are given the chance to do science that brings them closer to appreciate what science is, how it's done, and how it's a part of their lives. According to AFCD Archive 2004, the GLOBE activities are crucial for empowering students since they enhance their personal, intellectual, and educational growth.

2.4 Professional Development of Teachers

Literature reveals that for empowering students to achieve academically, teachers must see themselves empowered. In the context of this study, professional development is related to in-service teacher education around constructivist principles and practices and around the GLOBE Program. Day (as cited by Fiszer, 2004) states that professional development is a process by which teachers review, renew, and extend their knowledge, skills, and emotional intelligence to good professional thinking and practice. It offers teachers new way of thinking about learning, learners, and subject matters. Fiszer (2004) points out that professional training includes teachers attending workshops and seminars inside and outside the school. Teachers need to have continuous professional development during the course of their career to sustain their learning, which directly affects classroom practices. Teachers' professional development is important in the implementation of the GLOBE Program. Teachers need to develop intrinsic motivation for the Program to be able to guide students in their search of knowledge. This kind of motivation can be reached through increasing teachers' awareness of their role as the main facilitators of the Program (AFDC Archive, 2004).

According to Fiszer (2004), traditional professional development for teachers is not aligned with active learning. Teachers usually sit and listen to an expert who advocates hands-on learning for students but puts little of this talk into practice. As a matter of fact, this kind of professional development is no more applicable in such a changing environment. The GLOBE Program in Lebanon is trying to provide professional development programs for teachers that encourage them to take part in and practice all the protocols and activities they are going to apply later with their students. In the GLOBE training sessions teachers are learners themselves. They are learning by doing rather than hearing lectures on active learning of science (AFDC Archive, 2004). Fiszer (2004) maintains that teachers are like students; they need to work in steps on specific areas and receive experienced feedback before moving on. Therefore, professional development programs should follow the philosophy that knowledge is constructed through experiences (Brooks & Brooks, 1993).

In conclusion, the aim of this literature review was to show the relationships among constructivism, the GLOBE Program, students' empowerment, and teachers' professional development. The literature supports the idea that through implementing dynamic science programs, students are expected to be empowered in the sense of autonomy, decision- making, and ownership of their learning. Finally, in order for students to become empowered, teachers play a crucial role in initiating and facilitating students' learning.

Methodology

This chapter presents an overview of the methodology, the instruments that were used to collect data and the way they were administered. It outlines the research instruments used and measures taken to ensure validity and reliability of the study. The project examined teachers' and students' perceptions regarding GLOBE and its role in students' empowerment.

3.1 Target Group of this Study

The target schools are the American Community School (ACS) in Beirut and the Cedar Cultural School (CCS) in Qabershmoun, two schools that are actively implementing the GLOBE Program. Participants in this study are

- The GLOBE Coordinator in Lebanon, hereafter referred to as GLOBE Country Coordinator (GCC)
- The GLOBE teacher at ACS (Teacher 1)
- The GLOBE teacher at Cedars Cultural School (Teacher 2)
- Seven students purposefully selected by the researcher from both schools of three different achievement levels in science (2 high, 3 average, 2 low achieving students) and from different grade levels.

The purposive sampling was used whereby the researcher picked the cases to be included in his/her sample on the basis of her judgment of their typicality (Cohen & Manion, 1994).

3.2 Method

Since the aim of the study is to check whether the GLOBE Program is implemented properly in the selected Lebanese schools, and since we need to detect the effect of such implementation on students' empowerment, a qualitative research methodology provided an appropriate frame of work for this study. Three main methods were used to collect data: Semi-structured interviews, overt and covert observation, and document analysis. Data were triangulated through the use of more than one source.

3.2.1 Interviews

Semi-structured interviews were conducted with the GLOBE Coordinator in Lebanon, two GLOBE teachers, and seven GLOBE students from the two chosen schools. Permission for interviews was sought from the administration of the two participating schools. The interviews were audio-recorded after taking the permission of all the interviewees. Interviews took place in classroom settings and in office setting. Only one interview was via Internet with One ACS student who moved abroad due to the summer war.

Semi-structured interviews were used by the researcher. Three different sets of open-ended questions served as a guide during the interviews, one for the two GLOBE teachers, one for the GLOBE coordinator, and one for the seven selected students who were interviewed individually. The first interview was conducted with teacher 1, since she is the first teacher in Lebanon who integrated the GLOBE Protocols in the science curriculum. The first interview served as a guide for the researcher to decide on the questions addressed to the seven students. The second interview was conducted with the GCC to identify the obstacles their association is facing in the implementation of GLOBE

Program in the schools and why it is still used as an extra curricular activity or as part of non-formal education. The third interview was conducted with teacher 2.The researcher conducted this interview to collect data from two schools of different socioeconomic background aiming to check the main causes of the sustainability of the Program. The other seven interviews were conducted with seven selected GLOBE students from grade seven and six to check their views about the GLOBE Program. The first three interviews averaged thirty minutes in length and were done in office settings. The students' interviews averaged fifteen minutes in length and were done in classroom setting. The questions are provided in (appendix E). All the interviews were audio- recorded and later transcribed. Finally, the data were sorted and categorized according to the research purposes adopted in this study

3.2.2 Observations

The second method that was used in data collection for this study was observation of students in the field and in classroom. One observation session was performed on GLOBE students while they were taking atmosphere measurements in CCS. Another observation session was conducted in a grade six grade six class while covering one unit about the soil in the science class, using GLOBE "land cover" protocol. Observation took place in CCS for three days during the science sessions and in the time students were taking their atmospheric readings. While observing, the researcher looked for indicators of the empowerment of students. Some of these indicators were whether students had the freedom to choose the research question they are going to adopt, whether they had ownership and responsibility for achieving lesson objectives (further indicators are provided in appendix F that directed the observation of the researcher). In addition, the researcher made another observation at a conference that was held in Gefinor Hotel where two ACS students were presenting their GLOBE achievements in public in front of representatives from the American Embassy, Ministry of Environment, Ministry of Education, and a big group of teachers and principals. This observation provided the researcher with more indicators about students' empowerment.

3.2.3 Document Analysis

The analyzed documents were some of the seven participating students' science journals and portfolios in both schools for the purpose of determining to what extent GLOBE is implemented in the science units. Additionally, the researcher analyzed the sheets for data collection for the environmental measurements used by the students in both schools (see appendix C). The other documents that were analyzed by the researcher were:

- GLOBE portfolio of ACS
- GLOBE portfolio of CCS
- AFDC portfolio that includes all the projects, presentations, and trips performed by the GLOBE students during the past four years and to check students' performance and achievements during seminars, exhibitions, and science fairs.
- Portfolio of the annual GLOBE Fair where students present their research projects. This portfolio assisted the researcher in assessing students' performance and knowledge.

Therefore, the data were collected from multiple sources, from transcription of audio taped interviews, classroom and field observations, and from the analyzed documents. Data were collected and sorted in categories. In addition, data collected were analyzed in comparison to each other. Thus, this connection served to triangulate the data, since results were supported by more than one source of data.

3.3 Methods for data analysis

The interviews were recorded and transcribed; a list of categories was developed from the initial research statement. These categories are presented in details in the results' chapter. Transcripts were analyzed and coded. To ensure the validity, reliability, and trustworthiness of data collected, triangulation of data and sources was done by comparing the data collected from different methods and different sources. Robson (1993) states, "Triangulation is an indispensable tool in real world enquiry. It is particularly valuable in the analysis of qualitative data where the trustworthiness of the data is always a worry". Data collected from the teachers were compared with data collected from students. And data collected from teachers were compared to data collected from the GLOBE Coordinator in Lebanon to check whether the Program's aims were achieved.

The transcripts were analyzed in light of data collected from the observations done by the researcher and from the analyzed documents. Document analysis along with the interviews and observations assisted the researcher to triangulate the data.

Out of the observation sessions and the analyzed documents the researcher made a report then she tries to fit the data collected within the categories provided from the interviews.

The following chapter includes the results of the analyzed data collected from different sources and by different methods.

Results

This chapter presents the results found during the completion of the study at hand. The results were collected to achieve the following research objectives.

- Assessing the implementation of the Global Learning and Observation to Benefit the Environment (GLOBE Program) in two Lebanese schools and its impact on students' learning.
- Assessing the effect of the implementation of GLOBE Program on students' empowerment.

In order to achieve the above stated objectives, the data collected from the observations, school documents, and the transcripts obtained from interviews with the GLOBE Coordinator, GLOBE Teachers, and the students in two active schools were analyzed according to the following categories:

Category # 1: Constructivist Approach

1.1: Constructivist learning

1.2: Constructivist teaching

Category # 2: GLOBE Program

2.1: GLOBE benefits

2.2: Applicability and integration of GLOBE Program in the science curriculum

Category # 3: Students' empowerment

3.1: Importance of empowering students and teachers' perceptions about students' empowerment

3.2: Indictors of students' empowerment

Category # 4: Teachers' professional development

4.1: Teachers' perceptions about professional development

4.2: Type of GLOBE professional development conducted

Results showed how the GLOBE operates in these two Lebanese schools and its effect on students' empowerment specifically in the science curriculum.

The results of the field study can be summarized as follows:

Category 1: Constructivist Approach

1.1: Constructivist learning

Concerning the constructivist approach, the GCC stressed the idea of construction of knowledge where students are held responsible for building their own research and reaching their own results. This concept of 'learning by doing' supports the main premise of this study that the GLOBE Program enhances the application of constructivist learning. During the interviews many examples were highlighted by GCC about the students' visits to the fields to study various natural phenomena using the science process skills like observation, data collection and sorting, data analyses, and hypotheses verification (Bartholoew & Osbrone, 2004). In this context, the researcher had the chance to observe one student for two consecutive days while he was taking atmospheric measurements (see appendix B). These observations supported the premise that through GLOBE the students are using scientific skills in exploring environmental changes. These skills are enabling students to build their own research and to develop their own understanding.

Teacher 2 mentioned that students from different levels share knowledge and collaborate together to build up a common understanding about the environment and to find solutions to various issues affecting the globe. Additionally, the results showed that the GLOBE Program provides a floor for students to share their knowledge and skills. Teacher 1 explained how students from intermediate and high school levels enter to lower elementary classes to introduce the GLOBE Program and encourage younger students to check the weather conditions by themselves (refer to appendix G). Besides, the researcher's observations at ACS revealed that the GLOBE serves as a tool to experience the real environment and to study the drastic changes that took place during the July 6^{th} Lebanese war. The students worked on a study about the effect of the dumpsites of the destroyed houses on the quality of seawater after the July 6^{th} war in Lebanon. Teacher 1 affirmed the reliability of the data collected by the students during these four years that could assist in observing all the environmental changes that took place in Lebanon.

Teacher 2 highlighted the students' active search for knowledge to satisfy their intrinsic curiosity. Besides, GCC assured that students from different age groups are applying the basic and advanced scientific skills in developing and implementing their research.

1.2: Constructivist Teaching

According to the interviewed teachers, the GLOBE shifts the role of the teacher from being the only source of information to a facilitator who directs students' learning and inquiry. Along the same line, the seven interviewed students affirmed that their teachers usually act as facilitators.

Teacher 2 mentioned that through GLOBE activities the students develop the ability to question and argue about the information provided by teachers, and in some cases to investigate and to reach their own findings. GCC stated, "The teachers apply these scientific skills gradually." In addition, it is the teachers' role to modify these skills based on the abilities of their students.

Along the same line, Teacher 1 emphasized the importance of providing a climate where students can explore their surrounding using their senses. Additionally, Teacher 2 pointed out that the GLOBE teacher has the responsibility to assist the kids in developing higher order thinking skills.

The two interviewed teachers stressed the fact that GLOBE provides students with the opportunity to investigate their immediate environment in an organized and structured way. On the same point, GCC assured that this program would help students to know more about science. She focused on the concept "learning by doing". All the interviewees met on one point that the GLOBE is a typical program enabling improvement in science skills since in both schools the GLOBE students show good results in their science grades as well in the GLOBE Fair (refer to appendix H).

Category # 2: GLOBE Program

2.1: GLOBE Benefits

The interview conducted with GCC was beneficial because it provided significant and valuable results for the study at hand. According to the interviewee, the GLOBE Program is established mainly to make science education in the Lebanese schools more authentic. She stated that the Program has a basic concern to build thinking schools that emphasize inquiry and constructivist learning. GCC pointed out that: *"The GLOBE Program is an international science and environment program; it stands for global learning and observation to benefiting the environment. The GLOBE is based in US."*

One student stated:

"GLOBE to me means a lot... for example in GLOBE I learn a lot and it helps me a lot with science and taught me a lot about the environment and nature in different ways."

All the participating students in this study agreed that through GLOBE they would experience the environment richness. Additionally, students mentioned that through GLOBE they could collect environmental data from around the world and they will have a better understanding of earth. More over, students explained their ability to communicate with students, teachers, and scientists all around the globe.

Additionally, Teacher 1 explained in details the impact of GLOBE projects in benefiting her students to develop their ability to see the earth as interrelated systems and see the connection between what is studied in books and what is observed in the real environment. She stated:

"Students get to have hands-on application to real world science, by doing everything that they see in the textbooks and it is much more interesting to them; they remember it fast."

On the same point, GCC mentioned in sufficient details the major benefits of GLOBE. She stated:

"It helps students to apply science in real life so instead of doing science only in class and with books. We help them to know more about science what I want to say "learning by doing."

As noticed from the responses of teachers in both schools, GLOBE helps students to construct their own knowledge and question their understanding of the scientific concepts. Teacher 2 added on this point:

"It is making students discuss their findings and check whether the hypothesis they put is right or wrong. It is very beautiful for a student to prove his doubts by working on the ground."

Teacher 1 said on the same point:

"It will really help them to absorb, grasp and understand environmental problems and makes them feel that they can be part of the solution."

Furthermore, the interviewed teachers stressed the significant role the GLOBE plays in enhancing teamwork among students in the same school. Additionally, the AFDC GLOBE archive, 2004 reveals that students from different Lebanese schools work on common environmental projects. Teacher 2 gave an example about the project performed on Karou'n lake and explained that regardless of the students' socioeconomic background, their grade level, or the school they come from, all the students work in heterogeneous groups where they share information and take measurements, and report their findings. Teacher 1 added:

"In GLOBE there is no difference in grade levels it just GLOBE whether you are an elementary student or a high school student it is the same."

The interviewees in the three categories met on one point that the GLOBE is a typical program enabling improvement in science skills. The seven interviewed students emphasized that the major benefit of GLOBE is their ability to access more information and more people. One student commented that *we have more opportunities to access information and you get to contact scientists and students from other countries."*

Another student stated on the same point:

> "While you are having fun you are also learning, which is the same thing as school except its not as boring and it is enjoyable."

As noticed from the responses of teachers in both schools, GLOBE helps students to construct their own knowledge and question their understanding of the scientific concepts by enabling students to act as small scientists by applying science in their real environment. GLOBE is beneficial in enhancing science process skills like observing, classifying, and relating objects, since the whole program focuses on working with students to observe critically their environment.

Besides, the observation conducted by the researcher corresponded with the declarations made by all the interviewees who stressed the fact that the GLOBE Program entails the students to live a life- long experience combining education and fun.

2.2 Applicability and integration of GLOBE Program in the science curriculum

As for the integration of the GLOBE Program in the school curriculum, the interviewees agreed on the same answer that this Program could be applied mainly in the science curriculum. They asserted that the science teachers are willing to use it more, since it complements the science curriculum. It was made clear by the two teachers that through GLOBE the students are living a new experience of studying science.

As for its application in the schools, GCC assured that the implementation of GLOBE could start from grade four, although it is implemented in grade six in most of the Lebanese participating schools. This is due to its adherence to the preset Lebanese science curriculum. Teacher 1 mentioned proudly that her students are not satisfied anymore by the basic preliminary GLOBE protocols and activities; now they are working on more advanced ones. In addition, students are working on grants' writings to ensure the sustainability of the Program in their school. Where as to Teacher 2, she explained that its integration in their school is difficult due to the stress the teachers are facing in completing the assigned curricula. For this reason, the GLOBE is used as an extra curricular activity that may enhance students' understanding of the lesson.

The ACS Portfolio proves that most of the GLOBE protocols are integrated within the science curricula starting from grade 5 till grade 12 (refer to appendix G).

T1 affirmed clearly:

> *"We started to integrate it in the science curriculum in the elementary and middle school and in my class in particular I teach environmental science. And in the IB program we integrated every single unit into the class."*

Teacher 1 gave an example about the six graders who have a complete unit in their book on ecology. She introduced the GLOBE soil protocol and encouraged students to go and select a land cover study site to take measurements.

The interviewees, mainly the GLOBE Country Coordinator, stressed that the GLOBE Program can be applicable in all subject matters like science, math, and technologies; yet, the science teachers can apply it easily due to its similarities to the science curriculum. According to Teacher 1 science teachers can benefit from this program to enhance science process skills like observing, classifying, and relating objects, since the whole program focuses on working with students to observe critically their environment.

In CCS, the integration appeared to be minimal. The GLOBE is presented occasionally as a demonstration tool of a certain scientific activity. Teacher 2 mentioned that they use the GLOBE hydrology kit in chemistry sessions as a preparation for data collection in the field. The interviewee mentioned that the integration of GLOBE needs a full time teacher with no other obligations in order to reach its full potentials.

Finally, the GCC mentioned that AFDC has a vision to integrate the GLOBE Program in the science curricula at all the Lebanese schools to assure that the majority of students enjoy doing science by tackling real environmental issues like the weather conditions, water quality, and so forth.

Category # 3: Students' empowerment

3.1: Importance of empowering students and teachers' perceptions of empowering students

All the interviewees highlighted the significance of empowering students to give meaning to their own learning. Also, the results shown that "Students' empowerment" is a new term in Lebanon. Each participant defined it differently with relevance to his/her individual experience.

As for the GCC, Student's empowerment was clearer. She stated that when you empower you give people more responsibilities, it is shifting the decisions to students". Many examples were provided by GLOBE teachers about students' empowerment. We mention as an example what was pointed out by Teacher 1 about GLOBE students' participation in national and international GLOBE Conferences that developed their self-confidence.

She mentioned

"They are being ambassadors to Lebanon for once making others getting rid from a lot of misconceptions about Lebanon so that this is one reason why they feel empowered."

And,

"I don't even know everything they are doing because sometimes they are working on projects sometimes I learn about it when they make their presentations and I will think that is great because it is all students' work."

"They express their happiness from their ability to contact NASA and how NASA considers their data as original and important."

With regard to the ways Teacher 1 used to empower the students, the results have shown that students do research, collect data, and present their work locally, regionally, and internationally. While interviewing Teacher 1, the researcher induced a kind of disappointment when she mentioned that her students are prevented from achieving several projects due to financial issues that hinder their ability to travel to all the conferences that are held outside the country. For this reason she emphasized that the only way she can empower her students is to install in them the proper knowledge.

GCC stresses that it is essential to empower the students starting from early ages to feel a sense of ownership about their own learning and this can be achieved through the GLOBE Program. She added that GLOBE empowers students both socially and academically in a sense that the participating students develop better communication skills and better academic results in sciences. She claimed that there are many school directors who started to notice the improvement in students' achievement specifically in science and math

3.2: Indictors of students' empowerment

Teacher 1 explained that her students are empowered since they can provide reliable data for the science community. Students are encouraged to take part in their own learning and to hold responsibility; and be active learners instead of being self-directed learners. Through GLOBE students hold more responsibilities in their groups since the success of a group depends on collaborative work among the team members. Students feel that they can be part of the solutions for environmental problems and have the ability to reshape their surrounding.

Another student explained that he is more privileged than other students since he has wider exposure to different cultures. Teacher 1 mentioned that she usually delegate authority to the members of the GLOBE to develop their self-confidence.

Teacher 1 explained in sufficient details about the way her students present their studies in the international conferences and the self-confidence that usually gets the admiration of other people. The students at the CCS agreed with their teacher that the GLOBE helps them to develop self-confidence and to improve their abilities to speak in public.

However, to Teacher 2 empowerment is equivalent to ownership. GLOBE Provide motives to students to work harder since they feel ownership over their projects. According to GCC the indicators are classified into three main levels.

Intellectual level: GLOBE students reflected an effective use of analysis and higher order thinking skills.

Social level: GLOBE students are distinguished in their strong self-esteemed personalities.

Academic level: GLOBE students reflected a high performance in science

Along the same line, Teacher 1 explained that the main indicators of students' empowerment are that students have the full responsibility to make their own research and to come up with their own comprehension about their environment (refer to appendix I). They have the full freedom to choose their own research and the methods to be used in achieving them.

T1 claimed that:

> *"I am not a dictator that is why they can take ownership over their projects and by this they work harder since they are working on something that they are curious about."*

Besides, students' science journals are main indicators of empowerment where they show their satisfaction and happiness of being privileged of contacting NASA scientists and specialists from all around the globe. Additionally, delegating of authority to students in the Program implementation make them feel more empowered, since they have a full responsibility to keep GLOBE in the school.

However, to Teacher 2 to empower students is to equip them with the proper knowledge. GLOBE students feel more empowered since they have an ownership over their findings and have strong self-confidence and ability to speak in public.

Teacher 2 stated:

> *"The main source of their empowerment is the knowledge since knowledge is authority."*

She added that GLOBE students are simply empowered because they have access to students, teachers, and scientists from different parts of the globe and have wider exposure to different culture.

Moreover, Teacher 2 added on the same light that her students realized now the connection between science and math.

Category # 4: Teachers' professional development

4.1: Perceptions of GCC and teachers about professional development

According to the GLOBE Country Coordinator, teachers are the crucial agents in the implementation of GLOBE. They need to develop intrinsic motivation towards the Program since they can either lead to the success or failure of such a Program. They need to be trained to act as facilitators for students' learning.

As stated by the two interviewed teachers, the workshops provided at AFDC are enhancing their understanding and motivating them to work hard and challenge themselves. Besides, it is helping them to experience constructivist learning themselves. GCC explained in details that teachers are trained on the methodology used to apply such a program. Teachers are having the chance to do the same experiments they are going to apply with their students. She emphasized that GLOBE teachers have to work on themselves to reach to a stage where they can understand the constructivist nature of the Program. Teachers are urged to attend annual conferences, seminars, exhibitions, and workshops as part of their professional development. These workshops usually are made for teachers, students, and scientists to share their findings. Workshops are done for teachers to get training on a new protocol or a new approach of applying GLOBE. Teacher 1 added on the same point:

"Oh yes. Every time I learn more and help me to make the GLOBE better in school and to improve my teaching style as well."

4.2: Type of GLOBE professional development conducted

To Teacher 1 for any teacher to excel in the program she/ he need to stay up to date with the advanced topics provided by the GLOBE International Committee. She mentioned that "Training sessions help teachers to improve their teaching style."

For Teacher 1, teachers need continuous training to meet the objectives of GLOBE. The local, regional, and international workshops help the teachers to start GLOBE Elementary and to integrate it within the science curriculum.

The teachers from the two participating schools emphasized the importance of receiving the proper training to be able to apply the Program correctly with students.

On this point, GCC mentioned:

"The GLOBE teachers are usually trained on the methodology, on how to apply the Program, and then it is up to the teachers to make it applicable by the students up to their level."

Teacher 1 explained the way she took part in the program and she stated proudly that she attended the Teachers Training of Trainee's Workshop that enabled her to become a trainer herself to be able to train other teachers on the Program. Moreover, teacher 1 mentioned that she is in a continuous process of professional development since she is always benefiting from students' research. She stated proudly:

"I don't even know everything they are doing because sometimes they are working on projects sometimes I learn about it."

Out of the analyzed documents in both schools, it is clear that the GLOBE teachers are getting the proper recognition for their work in schools through official awards and certificates. Additionally, the teachers themselves are trying to provide their students' with the same recognition (refer to appendix J).

This chapter provided a report of the findings and interpretations collected through out the study. The following chapter will include the researcher's discussion of the results.

Discussion

In this chapter, the data are analyzed and interpreted in the light of the research objectives and the reviewed literature. The interviews were accompanied by observation reports in the two schools and the analyzed documents. Data from the interviews, observation reports, and documents provided were analyzed and compared to each other to triangulate the data. The study in hand focused on the facilitation of empowerment of students through the use of GLOBE Program that is rooted in constructivist movement in science education. The categories developed in the results' section guided the researcher analysis of the results.

1.1: Constructivist Teaching

According to Pintrich as cited by Lapan, Kardash, and Turner (2002), the most important aspect of constructivist teaching is that the focus will be shifted from teacher's identification of problems and solutions to students' identification.

Teachers are encouraged to reinforce their students' natural curiosity in their surroundings. Results revealed that GLOBE provides teachers with solid background information and learning activities both in the teachers' manual and on the Internet to help them in preparing their students for fieldwork. Howe and Jones, 1993 maintain that in a constructivist setting teachers' professional development guides the lesson rather than the books this is compatible with GLOBE. The information gathered from the first two interviews about the role the teachers play in enhancing students' natural curiosity is in agreement with the literature presented by Martin, Sigur, and Shmid (2005). The researcher noted that the responses of the interviewees showed some discrepancies among teachers' perceptions about constructivist teaching. Teacher 1 focused on her ability as a teacher to help students have an active search for knowledge and she assured that her role is mainly to facilitate their search. The following student's response conveys a message worth noting: *"All the projects are chosen by the students."*

On the other hand, the information gathered from interviewing students at CCS contradicts the literature that states that teachers allow the responses of the students to alter content and shift instructional strategies. She confirmed the sayings of her students by explaining that it is her role to set the objectives for the projects performed by students. This was clearly manifested in the transcribed interview when she stated: *"Usually I give the main objectives of the project and they go and make their research about the chosen topic."*

On the same point she claimed that even though she is sets the objective of the activity, yet she encourages her students to refute the initial hypothesis and to find new information. This is in concordance with Maurer (1998) who stressed the importance of engaging students in experiences that might engender contradiction to their initial hypothesis.

From the responses of the interviewees in both schools the researcher realized that constructivist teaching is performed at different levels in the Lebanese schools. The degree of effective application of constructivist approach in teaching depends heavily on the school's educational system. The information gathered via interviews confirmed the researcher's observations about the great effect of the school' educational system on the teaching methods adopted by teachers. Findings also revealed along the same line

Teacher 2 used constructivist approach in teaching as an individual effort and she claimed that she tried to motivate other teachers to take part in the implementation of GLOBE in her school, yet her trails failed since all the teachers are burdened by the requirements of the curriculum. On the same issue, Teacher 1 showed her disappointment of some teachers who are not motivated to improve their teaching skills. She said in a sarcastic tone:

> *"Some of them say oh here she is she is going to give us more work and others are showing appreciation for helping them to assist students see the interconnection among subject matters."*

GCC affirmed that the teacher is the main activator of such a Program in the schools for this reason as an association they are trying to target teachers' motivation to be actively involved in the Program.

1.2: Constructivist learning

Haynes and Gwendolyn (1996), emphasize that the purpose of education is not to transfer knowledge but to create environments and experiences that bring students to discover and construct knowledge.

The GLOBE neither begins nor ends with data collection. Usually scientists collect data to gain understanding and students can do the same.

Teacher 1 focused on the constructivist nature of GLOBE that aims at helping students build new learning by making connection to the previously stored knowledge through regular visits to the field and this is in harmony with the literature that mentioned that traditional learning styles provided students with limited practical and real life experiences. Constructivism allows students to experience learning and construct knowledge (Judi et al., 2003)

Additionally, GCC emphasized that through GLOBE students' learning will become more authentic and this coincides with the literature of Short and Greer (1994) that explained that learning occurs most effectively when it is situated in meaningful and authentic experiences.

Teacher 1 added on the same point:

> *"They can take ownership over their projects and by this they work harder since they are working on something that they are curious about."*

The observation report concurred with the data gathered from interviews especially at ACS that revealed their sense of proud of presenting their research in more than one country.

Furthermore, the observation report also was congruent with literature that stressed on the ability of students to construct their knowledge when they engage in social activities about shared tasks. All the interviewed students supported this idea where they expressed their abilities to work in heterogeneous groups and share their knowledge and skills.

Additionally, the students' presentation performed at Gefinor Hotel assured the students' self-confidence while talking in public. And this is as well compatible with AFDC GLOBE Archive-2004 about students' performance in exhibitions (appendix I) The researcher also reported that through out the interviews the students were answering the questions with ease and enjoyment.

According to Honebein 2005, there are three goals to enhance constructivist learning. These goals are summarized by empowering students by helping them to manage their own learning, situating learning in meaningful contexts to students, and finally promoting students' higher order thinking skills. These goals were in congruence with the findings of the study with some minor discrepancies in the indicators of empowerment since all the participants in the study has a different definition of empowerment. More over, the analysis of students' projects presented to AFDC reveals the ability of students to use the steps of a research method. It is worth noting that GLOBE students are trained on the basic and advanced research methods. Thus, GLOBE is compatible with the inquiry learning.

The information gathered from the interviews, observations, and analyzed documents conform mostly to the literature review that capitalizes on the natural curiosity of children (Martin, Sigur, & Smid, 2005). It focuses on encouraging students to wonder, ask questions, to find answers to these questions, and to build their own conclusions (refer to appendix D). Findings showed that there is a tight relationship between students' construction of knowledge and their academic achievements.

This is manifested by the sayings of GCC when she pointed to:

> *"One of the school principals mentioned that the science teachers are reporting better results for students in science."*

The interviewed teachers met with GCC who pointed out that through GLOBE they are targeting to build thinkers who will no more assume the passive role of receiving teachers' information as the only source of information. Along the same line, Teacher 1 experiencing discussion and argumentation. The assessment of students' portfolios has displayed growth and development in analytical thinking and problem solving (refer to appendix H).

2.2: Integration and applicability of GLOBE in the science curriculum

The implementation of GLOBE differs from one school to another depending on many variables such as the school educational system and the socioeconomic status of the school. Even though, the teachers and the GLOBE Country Coordinator agreed on the fact that the GLOBE minimizes the gap between students of different backgrounds, yet the researcher observations proved the opposite. It was noted that ACS GLOBE students are having more opportunities to travel and share in science fairs and work on more advanced projects due to the support of the US embassy to the Program in their school (appendix G). Additionally, at ACS there is a special teacher running the Program. The GLOBE is given great significance at ACS and it is integrated within the school curriculum in an organized and systematic way. Out of the transcribed interview with Teacher 1, it is noticed that through GLOBE there is a possibility to form connection among the subject matters that will assist students to have better understanding of their learning. Literature argued that through integration of subject matters, students develop the ability to form connection between the information they encounter in books and the information that is required to deal with real problems in life.

On the contrary, Teacher 2 expressed her disappointment of the lack of cooperation of other teachers and the limited resources the school has to implement the GLOBE Program. However, Teacher 2 showed her satisfaction of the results her students are achieving in shared research with other schools. The documents provided in appendix C assured that CCS is getting recognition letters from NASA regardless of their limited resources. She assured that this recognition is due to hard individual work she is making with her students. From here the researcher concluded that even though AFDC is providing schools with sufficient resources to run the GLOBE in their schools, yet without the administration support the program could not sustain. This corresponds to GCC comments that the directors of the schools need to get themselves some training on the implementation of the Program to adopt it as a philosophy of education.

According to research the study of environment provides an area of scientific research that is accessible to students in early ages. The findings were in harmony with the NASA Ames Center, 2004 that emphasized the importance of integrating the GLOBE in the science curriculum, since the students will have the opportunity to learn in a context in which knowledge is to be used. On the same point, Teacher 1 explained that through GLOBE the students are developing the ability to use information provided in one subject matter in another subject matter and in a new context. From here comes the importance of learning by doing where the student has the ability to transfer the knowledge provided in school in his/her real environment. All the interviewees stressed the concept "learning by doing".

It is noticed that at ACS the GLOBE Program is part of the curriculum. The GLOBE to ACS is an essential tool for the IB Program since it makes the connection and integration among subject matters more effective. However, in CCS the integration is limited and this finding contradicts with the AFDC archive, 2004. It is true that they are using it to accomplish some lessons in science specifically in chemistry yet its usage is as an activity that complement the curriculum or as a tool of demonstration.

3.1: Importance of empowering students and teachers' perceptions about students' empowerment

According to Dittmer et al. (1993) to empower is to make students eager to learn by going beyond classroom learning and relating it to real world contexts. The results of the present study indicated that to empower students is to become independent and lifelong learners. Those results are congruent with the literature that defines empowerment as the opportunities an individual has for autonomy, choice, responsibility, and participation in decision making (Lightfoot as cited by Short and Greer, 1994). Engaging students in workshops and activities provide them with the opportunity to take decisions. Along the same line, Stone (1995) emphasized the importance of providing students with a learning environment that encourages them to be effective decision makers. The transcribed interview with GCC comes in agreement with the literature in the sense that she revealed that through GLOBE they are developing students' leadership skills. These skills are developed through students' engagement in discussion and talks. Students agreed with the teachers and the GLOBE Country Coordinator that through their participation in GLOBE they feel more privileged since they are acting as small scientists. It enhances the use of inquiry methods. On the same light, Lapan, Kardash, and Turner, 2002 stated that positive engagement in classroom learning activities has been closely linked to increase in academic achievement.

The responses of students indicate that they are practicing limited empowerment especially at the CCS where the students work on accomplishing the project but they lack the ability to shift the objectives of a certain activity. According to their responses they prefer the teacher to set the objectives since they feel more secure. This comes with agreement with the literature that emphasized the importance of training students to hold more responsibility and ownership over their own learning (Stone, 1995). Additionally, teacher 2 indicated that the main factor in empowering students is the knowledge. Her words come in congruence with the literature stating that Knowledge is power (Mihesuah, 2003).

3.2: indictors of students' empowerment

As for students' empowerment, the study found that there is no single route to empowerment. The transcribed interviews indicated that every person has a different understanding of the word "empowerment". Nevertheless, all of the interviewees met on one point that GLOBE empowers them since it provides them more access to information and people. This finding is in harmony with the literature of Courtland, 2005 that defined empowerment as students having greater access and control over resources and their lives.

During the analysis process, five significant themes emerged as powerful aspects in improving students' empowerment. First, engaging students in self-evaluation helps them to become self-regulated students (Judi et al., 2003). Second, developing students' leadership skills encourage them to take responsibility over their decisions. Third, enhancing student' communication skills. Fourth, improving students' scientific understanding of the environment. Finally, developing students' ability to take risks by assisting them to work on new experiences.

The literature basically Robinson, 1994 stated that to empower the students is to provide them with more authority both socially and academically. GCC added in the same scope that to empower is to shift responsibility from teachers and delegate more authority to students.

It is a situation that enables students to see themselves as agent involved in the construction of reality rather than as objects. Thus, instead of being passive recipients the students will become the shapers of their own teaching and learning and this is supported by Courtland, 2005.

Teacher 1 affirmed that her students are continuously working on hot environmental issues that are of interest to them. This comes in agreement with Claus and Odgen, 1999 who argued that situated learning is the learning that is rooted in the lives, interests, and concern of students.

Students in GLOBE are provided with tools that enable them to do research independently, since the focus of GLOBE teachers is to teach students the process of doing research. It will be the students' responsibility to decide how to go through their research. Students in such a Program must realize their duties and responsibilities and work on fulfilling them. This comes in congruence with the process approach mainly the I-Search provided by Bowen, 2001 (Refer to appendix D).

Werner, 2002 argued that doing well on a desirable activity typically leads to an increased sense of competency and a commitment to continue the task, whereas failure has the opposite effect. This literature corresponds with Teacher 1 explanation about the importance of encouraging students to be responsible about collecting their own data and reaching their own conclusions.

4.1: Importance of Teachers' Professional Development

Haynes and Gwendolyn (1996) Literature reveals that in empowering students to achieve academically, teachers must see themselves empowered from here comes the importance of teachers' professional development where the teachers can reinforce and renew their information that affect classroom practices. Teachers are receiving the background knowledge that empowers them to exert an influence on their surrounding. To ensure the success of the GLOBE Program the teachers need to receive the proper training to be aware of their role as facilitators who can guide students' search for knowledge. The teachers' responses were in congruence with the literature of Fiszer, 2004 that stressed the importance of having proper training to assure effective implementation of the GLOBE Program (NASA Ames Research Center, 2004).

Teacher 1 claimed that the type of professional development she is receiving locally, regionally, and internationally are helping her to keep track with all the new protocols provided by GLOBE. She stressed that through these training sessions she is empowering herself.

4.2: Type of Professional Development Needed

A discrepancy was found between teachers' responses in the type of professional development needed. Both participating teachers assured that they are working on themselves to improve their knowledge and skills in GLOBE. Their responses come in accordance with NASA Ames Center, 2004 that revealed the importance of teachers' professional development to guarantee the sustainability of the Program. Along the same line, GCC highlighted the need for teachers to be trained on GLOBE Protocols and activities, since teachers are the main facilitator for such a program.

According to Lapan, Kardash, and Turner, 2002 the reward for engaging in the task would be the enjoyment and inspiration of the activity itself, not an outcome external to one's engagement in this interaction. This corresponds to teacher 2 who emphasized that every time she attends new workshop she feels highly motivated and feels that she can make a difference in her surrounding.

Furthermore, the transcribed interviews with the teachers prove that the type of training the teachers are equipped with affect the way the GLOBE is implemented in the school.

Conclusion

This chapter includes a summary of the major findings, limitation of the study, and recommendation for further research.

6.1: Summary of Findings

The main focus of the study was to check the effect of the implementation of the GLOBE Program on students' empowerment and students' scientific achievement. Students' empowerment should not be seen as a concept to be applied in certain hours of school day it is more to become a philosophy of education

Students' empowerment is crucial for the intellectual, educational, and social growth of students. Students would have the opportunity to learn a process for doing research that can be used for a lifetime. This study stressed the fact that through GLOBE the students will be more empowered on the intellectual, academic, and social levels. The students will have the ability to use higher order thinking skills starting from observation reaching analysis and synthesis. Moreover, the results showed that GLOBE students reported high achievement in science and math. Finally, the most important aspect of GLOBE is its ability to empower students socially through developing their ability to communicate in public and in small groups. The GLOBE encourage students to accept others' opinion and to share in the decision making process.

The assessment of results showed that giving children real responsibilities and decisions may promote their leadership skills since various studies in Lebanon showed that our students rarely experience taking decisions in their school environment.

Findings also proved that through GLOBE the students from different ages and grade levels conduct meaningful environmental measurements that stimulate their learning. It reinforces students' natural curiosity and interest in their surrounding.

This study revealed that the GLOBE could shift the role of the students in the classrooms from being passive recipients of teacher's information to active and autonomous learner. Furthermore, this study manifests clearly that meaningful learning occurs when there is collaboration between learners, teachers and specialists in the field.

Findings also showed that students are autonomous in choosing their projects and this has given them a sense of ownership over their learning.

The researcher concluded that empowering students embodies a major role for the teacher in directing, facilitating, and trusting their students to take responsibility. The teacher must create the suitable environment for students' learning to help them to self-evaluate. Besides, Teachers must realize their role and become acquainted with the skills that may empower their students.

6.2 Limitations of the Study

Studies revealed that different definitions are given to students' empowerment. From here one limitation that did appear that the students in the Lebanese schools did not know what the term students' empowerment implies even though they are practicing some of its aspects.

The second limitation of the study in hand is the inability of the researcher to have many observations in the field, since the schools participating explained that the political situation in Lebanon is preventing students from visiting the field regularly. Another limitation is the schools directors' lack of awareness about the benefits of GLOBE that may hinder its implementation in the schools.

6.3 Recommendations

The researcher recommends workshops for schools' director to make them realize the close connection between GLOBE and constructivist teaching and learning. Besides, these workshops may increase directors' awareness of the importance of integrating GLOBE within the curriculum due to its ability to make the connection among subject matters more effective.

As it was found in the study in hand, students could never feel the ownership of their learning unless they took active part in the process and become empowered to exert influence on their school environment. Additionally, the results revealed that students' empowerment depends on school educational system. From here comes the importance to do further research on the educational systems found in the Lebanese schools.

Finally, the researcher recommends having the GLOBE Program as part of the science curricula to make students see the connection between the science tackled in books and the science applied in their real environment.

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Appendices

Appendix A: Participating Lebanese Schools in GLOBE

Appendix B: GLOBAL measurements

Appendix C: Sheets of Data Collection

Appendix D: I- Search

Appendix E: Preplanned questions of the interviews

1. Interviews with teachers
2. Interview with the GLOBE coordinator
3. Interviews with Students

Appendix F: Indicators of empowerment

Appendix G: GLOBE Report- ACS

Appendix H: Sample of Students' assessment

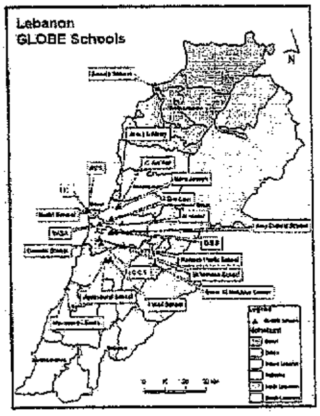
Appendix I: Sample of students' projects

Appendix J: Sample of GLOBE certificates

Appendix A: Participating Lebanese Schools in GLOBE

GLOBE

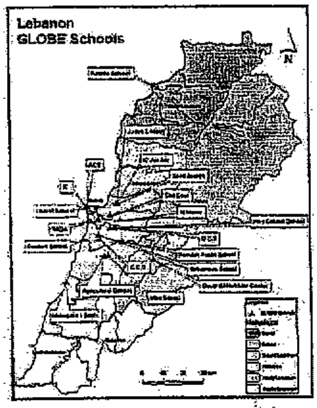
LEBANON



روضة الفيحاء - طرابلس
يسوع ومريم – قرنة شهوان
IC – عين عار
التوجيه والتربية - عاليه
المنار – رأس المتن
ACS - بيروت
الأرز الثقافية - قبرشمون
المقاصد - صيدا
الحريري الثانية - بيروت
الألمانية - بيروت
الزراعية - بعقلين
القديس يوسف – قرنة شهوان
عاليه الثقافية - عاليه
العرفان - السمقانية
عمر المختار – البقاع الغربي

GLOBE

LEBANON



الوطنية الرسمية
بشامون الرسمية
القلبين الأقدسين – عين نجم
IC - بيروت
YASA

GLOBE

GLOBE New Schools

المدارس التي ستنضم إلى البرنامج هذا العام

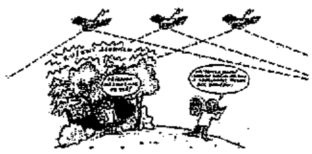
مدرسة الأهلية – قبلياس، البقاع
مدرسة التأهيل التربوي – الصرفند
ثانوية صيدا الرسمية للبنات – صيدا
ثانوية القلعة – صيدا
مدرسة عندقت الرسمية – عندقت، عكار
مدرسة رأس المتن الرسمية – رأس المتن
ثانوية برجا الرسمية – برجا، الإقليم
مدرسة الغربية - عاليه

LEBANON

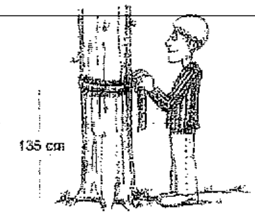
Appendix B: Samples of GLOBAL measurements

بروتوكولات وقياسات برنامج GLOBE

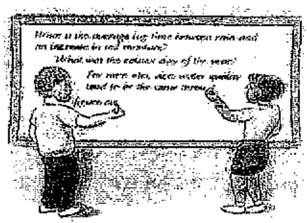
البروتوكول	القياسات	المرحلة التعليمية
الجو المناخ البروتوكول	غطاء ونوع الغيوم	كل المراحل
	الجزيئيات	المتوسط والثانوي
	التساقطات (المطر، الثلج)	كل المراحل
	الضغط الجوي	كل المراحل
	الرطوبة	كل المراحل
	PH التساقطات	كل المراحل
	الحرارة	كل المراحل
	الأوزون	كل المراحل



البروتوكول	القياسات	المرحلة التعليمية
المياه	الشفافية	كل المراحل
	حرارة المياه	كل المراحل
	الأوكسجين المذاب	المتوسط والثانوي
	الموصلية الكهربائية	كل المراحل
	PH المياه	كل المراحل
	درجة الملوحة	كل المراحل
	القلوية	كل المراحل
	النيترات	كل المراحل

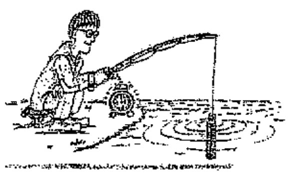


البروتوكول	القياسات	المرحلة التعليمية
التربة	الخصائص الفيزيائية: الانحدار، الطبقات، العمق، البنية، اللون، التماسك، الجوهر والكربونات	كل المستويات
	الخصائص الكيميائية: الكثافة، الحجم، الخصوبة والـ PH	كل المراحل
	رطوبة التربة	كل المراحل
	الترشيح	كل المراحل
	درجة حرارة التربة	كل المراحل



البروتوكول	القياسات	المرحلة التعليمية
الغطاء الأرضي البيولوجيا	وضع خرائط غطاء الأرض	كل المراحل
	التعرف على أنواع النباتات	كل المراحل
	البيولوجيا الاحصائية: محيط وارتفاع الشجرة، غطاء الظلة، غطاء الأرض، الأعشاب	كل المراحل
	الفصول	كل المراحل

البروتوكول	القياسات	المرحلة التعليمية
الموقع الجغرافي	قياس خط الطول، خط العرض والارتفاع	كل المراحل

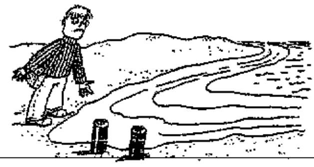


البروتوكول	القياسات	المرحلة التعليمية
حياة النبات	مرحلة نمو النباتات	كل المراحل
	مرحلة ضمور النباتات	كل المراحل

برنامج التربية والتوعية البيئية - جمعية حماية وتنمية الثروة الحرجية (AFDC)
هاتف: ٩٦١٠٢٨٠٤٢٠ / فاكس: ٩٦١٠٢٨٠٤٣١ / afdc@afdc.org.lb / www.afdc.org.lb

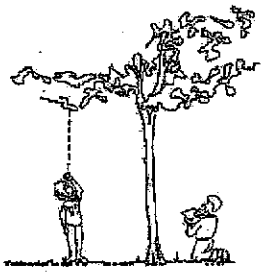
GLOBE Protocols and Measurements

Protocol	Measurements	Skill level
Atmosphere Climate	Cloud Cover / Type	All
	Aerosols	Middle, Secondary
	Barometric Pressure	All
	Relative Humidity	All
	Precipitation (rain – snow)	All
	Precipitation PH	All
	Air Temperature	All
	Surface Ozone	All

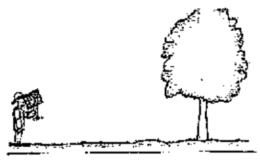


Protocol	Measurements	Skill level
Hydrology	Transparency	All
	Water temperature	All
	Dissolved oxygen	Middle, Secondary
	Water PH	All
	Conductivity	All
	Salinity	All
	Alkalinity	All
	Nitrate	All

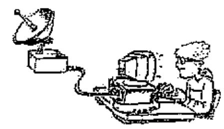
Protocol	Measurements	Skill level
Soil	Physical Characterization: Slope, horizons, depth, structure, color, texture, consistence, carbonates	All
	Chemical Characterization: Bulk density, particle size, particle density, soil PH, fertility	All
	Soil moisture	All
	Infiltration	All
	Soil Temperature	All



Protocol	Measurements	Skill level
Land Cover Biology	Land cover mapping	All
	Species identification	All
	Biometry: Tree circumference, tree height, canopy cover, ground cover, grass b	All



Protocol	Measurements	Skill level
GPS	Longitude, Latitude & elevation of site	All



Protocol	Measurements	Skill level
Phenology	Green – up	All
	Green – Down	All

Environmental Education and Awareness Programme
Association for Forest Development and Conservation (AFDC)
Tel: (961) 5280430 – Fax: (961) 5 280431 – Email: afdc@afdc.org.lb – Web Site: www.afdc.org.lb

Appendix C: Sheets of Data Collection

Atmosphere Investigation

Data Work Sheet

School Name ______________________________

Observer Names ______________________________

Measurement method for pH: ☐ paper ☐ pen ☐ meter

	Sat.	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.
Date							
Hour (Universal Time)							
Observer Names							

Cloud type (Check all types seen)

Cirrus	☐	☐	☐	☐	☐	☐	☐
Cirrocumulus	☐	☐	☐	☐	☐	☐	☐
Cirrostratus	☐	☐	☐	☐	☐	☐	☐
Altostratus	☐	☐	☐	☐	☐	☐	☐
Altocumulus	☐	☐	☐	☐	☐	☐	☐
Stratus	☐	☐	☐	☐	☐	☐	☐
Stratocumulus	☐	☐	☐	☐	☐	☐	☐
Nimbostratus	☐	☐	☐	☐	☐	☐	☐
Cumulus	☐	☐	☐	☐	☐	☐	☐
Cumulonimbus	☐	☐	☐	☐	☐	☐	☐

Cloud Cover (Check one)

Clear	☐	☐	☐	☐	☐	☐	☐
Scattered	☐	☐	☐	☐	☐	☐	☐
Broken	☐	☐	☐	☐	☐	☐	☐
Overcast	☐	☐	☐	☐	☐	☐	☐

Rainfall

Number of days rain has accumulated							
Rainwater in rain gauge (mm)*							

** Remember:*
Record 0.0 when there has been no rainfall or snowfall.
Record M if the measurement is lost or missing for this day.
Record T for trace amount of rainfall (less than 0.5 mm) or snowfall (too small to measure).

Hydrology Investigation

Data Work Sheet

School name: ____

Student group: ____

Site Name: ____

Sample collection date: ______ time: ______ (hours and minutes) check one: UT___ Local ___

Transparency

Cloud cover (check one): ____ clear ____ scattered ____ broken ____ overcast

Secchi Disk:

Observer 1: Length of rope: when disk disappears: ______ m when disk reappears: ______ m

Distance from where the Observer 1 marked the rope to the Water Surface: __________ m

Observer 2: Length of rope: when disk disappears: ______ m when disk reappears: ______ m

Distance from where the Observer 2 marked the rope to the Water Surface: __________ m

Observer 3: Length of rope: when disk disappears: ______ m when disk reappears: ______ m

Distance from where the Observer 3 marked the rope to the Water Surface: __________ m

Turbidity Tube:

Water line in tube when image disappears:

Observer 1: ______ cm Observer 2: ______ cm Observer 3: ______ cm

Water Temperature

Observer 1: ______ °C Observer 2: ______ °C Observer 3: ______ °C Average: ______ °C

Dissolved Oxygen

Observer 1: ______ mg/L Observer 2: ______ mg/L Observer 3: ______ mg/L Average: ______ mg/L

Kit manufacturer and model: ____

pH

Measurement method: _____ paper _____ pen _____ meter

Value of buffers at site: pH 4: ______ pH 7: ______ pH 10: ______

Observer 1: ______ Observer 2: ______ Observer 3: ______ Average: ______

Conductivity

Conductivity Standard: ________ MicroSiemens/cm (µS/cm)

Observer 1: _____ µS/cm Observer 2: _____ µS/cm Observer 3: _____ µS/cm Average: ______ µS/cm

Land Cover/Biology Investigation

Field Data Work Sheet

★For Land Cover Sites Only:

★Type of Site: ☐ Biology Site ☐ Land Cover Site | ☐ Training Site ☐ Validation Site | ☐ Qualitative Site ☐ Quantitative Site

Site Name:__________________ ★Country/State/City:________________________

★GPS Location: Lat.___________ Long.___________

★Date:________ ★Time:________ Recorded by:________________________

MUC Level 1 Land Cover Class: Name: ________ Code:________

If class 2, 3, or 5 - 9, **Stop Here.** If this is a Qualitative site, **Stop Here.**

Dominant & Co-Dominant Vegetation (Genus & Species) -- See Dominant/Co-Dominant Vegetation Field Form.

If Forest or Woodland: ★Dominant:______ ______ ★Co-Dominant:______ ______

If Herbaceous:

★ Dominant: ☐ Grass ☐ Forb

★ Co-Dominant: ☐ Grass ☐ Forb ☐ Trees: Genus:_______ Species:_______

Biometry Data

Record Data from the *Dominant/Co-Dominant Vegetation Work Sheet*

Canopy Cover:

Total +'s_____ Total –'s_____ Total Observations______ % Canopy__________

Ground Cover:
Total G's_____ Total B's_____ Total -'s_____ Total Observations______ % Ground Cover__

Percent Evergreen and Deciduous:
Total E's_____ Total D's_____ Total Canopy (E + D)_____ % Evergreen_____ % Decid.____

Percent Graminoid or Forb:
Total Grasses_____ Total Forbs_____ Total Obs._____ % Grass_____ % Forbs_____

Soil Investigation

Soil Characterization Data Work Sheet

Site Name: ____________________ *Form Number:* __________ *Slope:* _____ ° *MUC:* _____

Method (choose one) Pit or Near Surface ______ *Auger* ______ *Existing Exposed Soil Profile* ______

Other Site Characteristics: ____________________

HORIZON (letter or number)	TOP DEPTH (cm)	BOTTOM DEPTH (cm)	MOISTURE (wet, moist, dry)	STRUCTURE (type)	MAIN COLOR (code from color book)	SECOND COLOR (code from color book)	CONSISTENCE (loose, friable, firm, extremely firm)	TEXTURE (name)	ROCKS (none, few, many)	ROOTS (none, few, many)	CARBONATES (none, slight, strong)

NOTES:

Biology/Land Cover Investigation Field Data Work Sheet (continued)

Dominant Species:________ ________	**Co-Dominant Species:**________ ________
Tree Height:___m ___m ___m ___m ___m	Tree Height:___m ___m ___m ___m ___m
Tree DBH:___cm___cm___cm___cm___cm	Tree DBH:___cm___cm___cm___cm___cm
If Grass- Green Biomass:___g/m^2 ___g/m^2 ___g/m^2	If Grass- Green Biomass:___g/m^2 ___g/m^2 ___g/m^2
Brown Biomass:___g/m^2 ___g/m^2 ___g/m^2	Brown Biomass:___g/m^2 ___g/m^2 ___g/m^2

Biometry Summary

★Canopy Cover:_____%

★Ground Cover: Green:_____% Brown:_____% Total: ______%

★Average Tree Height:____m ★Average Tree DBH:____cm

★Avg. Green Biomass:____g/m^2 ★Avg. Brown Biomass:____g/m^2 ★Total Biomass:____g/m^2

MUC Land Cover Class

★Level 2 Name:________ Code:________

★Level 3 Name:________ Code:________

★Level 4 Name:________ Code:________

Notes:____

____

Photographs:____

____

Phenology (optional)

★Event (check one): ❑ Bud-Break ❑ Senescence

(Do canopy cover or ground cover measurements - other side)

★Canopy Cover:____% ★Percent Green in Canopy (estimate):____%

★Ground Cover: Green____% Brown____% Total:____%

Soil Investigation

Soil Moisture Data Work Sheet - Transect Pattern

Site Name: ______________________________

Name of Collector/Analyst/Recorder: ______________________________

Sample collection date: _______

time: _______ (hours and minutes) check one: UT___ Local ___

Current Conditions: Is soil saturated? Yes _____ No _____

Drying Method: 95-105 °C oven ____; 75-95 °C oven ____; microwave ____

Average Drying Time: _________(hours or minutes)

Daily Metadata: (optional)

~~Length of Line: ________ m Compass Bearing: ______ Station Spacing: _____ m~~

Directions:

Transects should be 50 m long, located in an open field. Measurements are made 12 times/yr. during a regular interval of your choice. Enter the data for your samples collected between 0-5 cm (10 single samples plus 1 triple sample):

Observations:

Sample Number	Offset from end of Transect (m)	Container Number	A. Wet Weight (g)	B. Dry Weight (g)	C. Water Weight (A-B)	D. Container Weight (g)	E. Dry Soil Weight (B-D)	F. Soil Water Content (C/E)x100
1								
2								
3								
4								
3								
5								
6								
7								
8								
9								
10								
11								
12								
13								

Appendix D: I SEARCH

Students personalized their I-Search and proceeded through the steps using the four primary I-Search questions:

* What do I want to know?

* Where can I find the answers?

* How will I record the information that I find?

* How will I show what I learned?

Appendix E: Preplanned questions of the interviews

Pre-planned questions of the Interview: with the GLOBE Coordinator

- What is the GLOBE Program? And how are you implementing it in the schools?
- How many schools are participating in such a program?
- What are the benefits or values of implementing the GLOBE Program in schools?
- To what extent are the schools actively involved in this program?
- Is the Globe Program, in the participating schools, given as a separate subject matter or integrated within the curriculum?
- If integrated, in what subject matters can you have an effective integration of such a program? And why?
- To what extent can the GLOBE Program empower students? And in what aspects?
- What are some of the limitations you are facing in implementing such a program in the Lebanese schools?
- What kind of training are you providing teachers and students with to make them apply such a Program?
- What makes ACS the first school in Lebanon that applies the GLOBE Program? Is it because of financial resources or because of the school's system?
- What are some of your recommendations for better application of the GLOBE Program, in order to improve science learning?

Pre-planned questions of the Interview for GLOBE teachers:

- When did you start the GLOBE Program in your school?
- What kind of training did you receive that enabled you to apply such a Program?
- In your opinion, what are the main benefits of the Program?
- To what extent do you think you are contributing to the success of the implementation of the GLOBE Program in your school?
- Do you consider that your GLOBE students are more privileged than other students? If yes, why?
- To what extent do you feel that this Program is empowering your students? And in what aspects?
- If your students are empowered, what are the indicators that you check to assure that your students are empowered?
- Who will decide on the projects the students will make during the year?
- For you how the GLOBE Program and science curriculum are related?
- Why did you decide to implement such a Program in the science curriculum? And why you did choose grade six?

Pre-planned Questions for the interview with GLOBE Students

- What does GLOBE mean to you?
- Are you enjoying the GLOBE activities? Why?
- Are you a member in the GLOBE Club?
- If yes, why did you decide to participate?
- As you know that the GLOBE is based on projects, do you have the freedom to decide on the research you want to work on?
- What are the steps you follow to make your research and projects?
- What are you learning from GLOBE activities?
- Are the GLOBE activities assisting you in understanding the scientific concepts found in your books?
- What is the role of your GLOBE teacher in such activities?
- Do you consider yourself more privileged than the other students as a GLOBE member? If yes, in what sense?
- Who decides on the experiments to be conducted in order to answer a research question?
- What aspects in the GLOBE make you satisfied and enjoyed?
- If you want to advise a friend to participate in the GLOBE Program, what will be the reason for your advice?

Appendix F: Indicators of Empowerment

Indicators of student students' empowerment: 10 elements

1. Students have confidence to present their projects and speak in public
2. Students freedom to choose the research question they are going to adopt
3. Whether they had ownership and responsibility for achieving lesson objectives
4. Students are able to take GLOBAL Measurements
5. Students have the ability to analyze their findings
6. Whether participating students are excelling in science classes
7. Ability of students to make connections and build hypothesis
8. The students have the ability to do research
9. The students have consideration of the changes that are taking place in their immediate environment
10. The students consider themselves as active agent that can make a change in their learning

Appendix G: GLOBE Report - ACS

Report on GLOBE Program Activities, 2004 – 2005

Recommendations and Long Term Goals & Elementary Middle School and High School Curriculum Integration

Prepared by: Teacher 1

1. Daily collection of atmosphere data.

    - Academically strong, mature, and independent Grade 5 students were chosen in each homeroom to be leaders and assistants in training their fellow classmates in daily data collection. Students missed 20 – 30 minutes of class once per cycle to collect and enter the atmosphere data. The chosen grade level representatives missed recess 2 times per week for sampling on a rotating basis. Students used the weather station on the east roof of the BD building to collect data on cloud type, cloud cover, humidity, rainfall, snowfall, precipitation pH, surface ozone, aerosol readings, maximum, minimum, and current temperature.
    - The GLOBE Coordinator collected atmosphere data on the weekends.

2. Weekly collection of hydrology data.

    - During advisory Stuart MacDonald took out a team of students on a rotating schedule to collect hydrology measurements on the shore at Riviera Beach. During class students were introduced to the GLOBE protocols and given a background in the chemistry concepts necessary to understand the GLOBE studies. Students collected data on water transparency, temperature, pH as well as nitrate, alkalinity, dissolved oxygen and salinity concentrations.

Students did not miss any class time for sampling. The fact that we did not have a budget to purchase equipment inhibited the continuity of the sampling.

3. Weekly collections of soil data (April, May and June only)

    - During advisory one teacher took out a team of students on a rotating schedule to collect soil measurements at the soil study site near campus. During class students were introduced to the GLOBE protocols and given a background in the ecological concepts necessary to understand the GLOBE studies. The sampling corresponded to the ecology unit taught in the spring of 2005. Students collected data on soil characterization, temperature, depth profiles and GPS. Students did not miss any class time for sampling.

4. Outdoor Education Program Integration:

    - During the grade 11, 10, 6, 5, 4 and 3 Outdoor Education Grade Level Retreats, the GLOBE concepts were introduced and science activities and sampling were integrated into the schedule.

5. High School course integration

    - The IB Environmental Systems class integrated the GLOBE concepts and protocols into the curriculum. An overnight retreat in the field was designed to introduce the GLOBE sampling procedures and concepts early in the year. A concentrated training session took place in the field, for two days. These concepts were then brought back to the classroom and developed upon throughout the year. Some students chose to use the GLOBE concepts for their IB senior essay.

6. After-school GLOBE atmosphere program for Grade 5 GLOBE students

- Students met once per week for one hour after school (in addition those who traveled to Qatar meet twice per week during January, February and March). Students participated in learning activities and experiments related to the GLOBE data they were collecting.

7. After-school GLOBE phenology, land cover and hydrology program for MS students
    - MS students collected weekly phenology and land cover data in Lebanon in addition to the hydrology data at a site on the Mediterranean just below the Corniche. Students collected data on water temperature, pH, transparency, salinity, and dissolved oxygen.
8. After-school GLOBE phenology and hydrology project
    - The high school students and some of the elementary students joined students from other GLOBE schools in Lebanon to complete joint phenology work on 2 occasions.
    - Nahr el Kalb hydrology project: Grade 10, 11 and 12 students collected data weekly as part of an investigation of the extent to which nitrate levels influence the growth of algae. The students collected data on water temperature, pH, transparency and alkalinity Workshop participation
    - Several Grade 5, 6 and 7 students participated in the GLOBE introductory workshop held at the AFDC in June.
    - Grade 11 and 12 students participated in a GLOBE soil, atmosphere and land cover workshop held in Tannourine in September.

11. Presentations at the YouthCAN Environmental Conference at ACS

- 7 elementary and 6 middle school students presented the results of their 2 year long research study on weather and climate in Lebanon.

12. Conference participation

- 7 Grade 5, 2 Grade 6 and 4 Grade 7 students participated in the 2005 Middle East Regional GLOBE Conference in Doha, Qatar in March of 2005. These students received an award in recognition of their research by visiting NASA scientist from the United States and the US Ambassador to Qatar.
- 3 Grade 10 and 1 Grade 11 student participated in the GLOBE Games in the Czech Republic in May of 2005. These students received recognition by GLOBE headquarters in the USA and GLOBE Europe for their dedication and hard work.
    - In addition the HS GLOBE team prepared a PowerPoint presentation in order to help cultivate positive reflections about Lebanon and the region to the Czech community and the conference participants on Lebanese culture, geography, history and dance. As a result ACS sister schools in Croatia, Norway, Switzerland and the Czech Republic feel more comfortable sending their students abroad to visit Lebanon during the GLOBE Conferences.

Most GLOBE students reported that they found preparing for and presenting at the international GLOBE conferences and the YouthCAN conference to be the most challenging as well as the most fun part of GLOBE this year.

This year was a pilot for the integration of the program into the 5th, 6th and 7th Grade Curriculum. While Grade 5 students struggled with the data collection at first, by the end of the year, many of the Grade 5 students were able to work independently and made valuable contributions to the data collected for the report. In order for the program to continue the homeroom teachers must be certified so that they can truly integrate the program into their curriculum. Currently the GLOBE Coordinator is teaching all four sections in grade 5 and 1 section in grade 2 in the GLOBE concepts and taking students out for daily measurements without help. Grade 6 students got a late start in the program this year, but are getting the hang of sampling. It is advised that they have more preparation time in class before sampling. As a whole they are having problems finding interconnections on their own. A solid background in the concepts will help in the future.

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Recommendations for 2005-2006

ES

The grade 4 and 5 homeroom, computer and MS science, and computer teachers are interested in receiving GLOBE training. This training is essential for program integration into the science curriculum of these grade levels. Teacher 1 will host a GLOBE Teachers Training during the first 2 weeks of professional development for teachers. The homeroom teachers need to be certified so that they can teach their students themselves and understand what they are studying. The computer teacher also needs training so she can help the students in the data entry and making graphs on the GLOBE website. Students who wish to take on a GLOBE project of their own interest should be encouraged to and guided into developing it their IB senior exit essay.

It is advised that the aerosol study as well as Eratosthenes experiment "How big is the earth" study is introduced to the physics class with the concepts and if the instructor wants to incorporate the sampling into a research study with the class this is highly encouraged.

IT:

1. A GLOBE student account accessible for all students
2. A GLOBE photos and projects account to hole all photos for projects including satellite images
3. A GLOBE Teachers account for training info, curriculum, activities and PowerPoint's so that all the GLOBE teachers can access the information on one account without having to give all the information to each teacher.
4. A minimum of 5 computers with Internet connection for students in the GLOBE/Outdoor Education room.
5. A LCD Projector in the GLOBE/Outdoor Education room.
6. Printer access in the room or on the floor of the HS BD area on the first floor of the HS BD area near the GLOBE/Outdoor Ed office/classroom/storage.

Conferences:

Virtual Science Fair with all NESA GLOBE Schools (All)

Annual Middle East GLOBE Conference (MS and ES)

Science Fair Conference in Bahrain (All)

International GLOBE Games in Europe (HS)

Recommendations for 2006-2007

ES

In order to integrate the concepts into their science curriculum, training grade 4, 3 and 2 teachers is necessary. Update the grade 5 teachers in the program with new protocols and new arriving faculty to the grade 5 team.

MS

Training for any new faculty in the science department if any.

HS

Update training for IB Environmental Systems teacher in new protocols and look into program integration in the grade 9-science coursework.

GLOBE Coordinator:

GLOBE Annual Conference for educators

Conferences:

Annual Middle East GLOBE Conference (MS and ES)

International GLOBE Games in Europe (HS)

GLOBE Learning Expedition in Thailand spring 2007 (HS MS and ES). The GLE is a global conference that takes place every 4 years. The best research projects are chosen from each region in the world to present their studies and participate in trainings and workshops. There are specialized workshops for the teachers as well as the school coordinator with information on the new GLOBE protocols developed over the years.

Appendix H: Samples of students' assessments

AFDC

The GLOBE Program

GLOBE Lebanon

1st GLOBE Regional Young Scientists Challenges Fair

Judgment Form

April 26, 2006

Project Title: ____________________________

Name of school: ____________________________

Name of students: ____________________________

Name of teacher (supervisor): ____________________

Judge's name: ____________________________

- Please give a score according to the following criteria
- The allocated total score is indicated bellow.

Evaluation Criteria:

1. Problem (8 points):

	Score	Total Score
To what degree is the problem new?		4
How well is the problem stated and written?		4

2. Creative Ability (8 points):

	Score	Total Score
How unique or original is the idea of the project?		4
Is it significant or unusual for students at this age?		4

3. Scientific Thought (16 points) :

	Score	Total Score
Does the project follow scientific methods?		4
Is the problem clearly stated?		4
Are the procedures appropriate and organized?		4
Is the information collected accurate and complete?		4

4. Understanding (12 points):

	Score	Total Score
Does it explain what the students learned about the topic?		4
Does the project represent real study and effort?		4
Does the project show the students are familiar with the topic?		4

5. Clarity (How clear the students discuss and explain their project) **(16 points):**

	Score	Total Score
Do the students clearly communicate with the nature of the problem and how the problem was solved?		4
How clear do the students present the purpose, procedures, data, results and conclusion?		4
How well does the project display explain the project?		4
Is the objective and procedures of the project likely to be understood by one not trained in the subject area?		4

6. Dramatic Value (How well does the project display explain the project?) **(24 points):**

	Score	Total Score
Is the display visually appealing?		4
Is the proper emphasis given to important idea?		4
Are all the components of the project done well?		4
Where did the equipment come from?		4
Was it built independently by the students?		4
Where did the students work on their project?		4

7. Technical skills

	Score	Total Score
Was the work done by the students?		4
Have the students acknowledged help received from others?		4
Is the project physically sounded and durably constructed?		4
Was the project skillfully designed and was not too complicated?		4

Two Positive Points (10 points) :

1. ____

____

Score	Total Score
	5

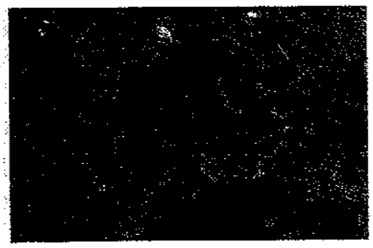
2. ____

____

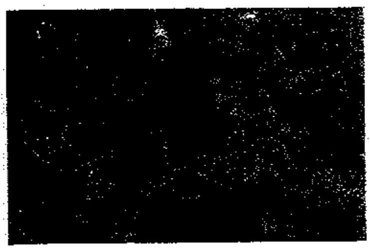
Score	Total Score
	5

Appendix I: Sample of students' projects

Appendix I: Sample of students' projects



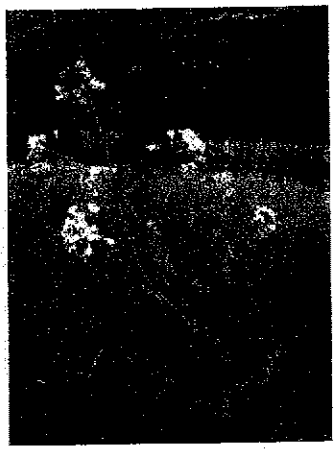
Soil Characterization and Fertility Comparisons Between Irrigated and Non-irrigated Soil



Soil Characterization and Fertility Comparisons Between Irrigated and Non-irrigated Soil

By:]

American Community School 2006



Title: Soil Characterizations and Fertility Comparisons Between Irrigated and Non-Irrigated Soil.

Purpose:

The purpose of this experiment was to compare the soil characteristics and the soil fertility levels between the non-irrigated soil and irrigated soil in Beirut Lebanon. The non-irrigated site was on the campus of the American University of Beirut in a natural wooded area, while the irrigated site was in a grassy manicured area on the campus of the American Community School of Beirut. Observations on whether or not it is best to irrigate and cultivate an urban area or whether to leave it uncultivated were investigated. The hypothesis was that the areas that were irrigated would be of higher fertility levels and moisture content which may effect the soil characterization.

Hypothesis:

The grassy non-irrigated soil is going to be less fertile and have a lower nutrient content than the wooded irrigated soil. The non-irrigated soil will have a lower level of soil moisture and less life such as earthworms in the soil. The soil characteristics will be the same. Therefore it is best to grow plants in an irrigated commercial environment than a non irrigated naturally wooded environment.

Research Methods:

Soil samples were taken weekly at The American University of Beirut and The American Community School from 11:30am-12:30pm. Soil samples were taken using a soil auger to obtain a soil core of 1 meter depth. The Soil was laid out on a trash bag. To differentiate between the horizons, toothpicks were placed to divide them. Soil Structure and the size comparisons were tested to see if they are single grained or massive. The soil sieves were used to determine if the soil is granular, prismatic, columnar, blocky or platy. Soil color is another guideline tested, using the *Soil Guide for Soil and Earthtone Colors by: Color Communication Inc.* to match the colors of the soil. The most dominate color was noted first then the non dominant was marked as well.

To determine the soil consistency a soil ped was taken and squeezed to see if it was loose, friable, firm or extremely firm in addition the soil texture was determined by spraying water on the ped, observing how sticky the soil was and then to see if a ribbon can be formed with the soil. This analysis was used to determine if the soil was made up of sand, silt, clay or a mixture of the three. Size comparison was determined using the soil pyramid. Testing for free carbonates was done by spraying white vinegar on the soil and observing if there was a chemical reaction, if it didn't bubble then it proves that there was no reaction "none", if it is bubbling but very little it is "slight" if it is bubbling a lot it is "strong". A strong reaction means that there are high concentrations of calcium carbonates in the soil which will make the soil more basic.

The Soil pH or acidity was then tested by mixing 40grams of soil with 40ml of distilled water and then mixing them for 30 seconds every three minutes for a total of five mixing intervals. The pH of the soil can help determine what plants can grow in the soil to their optimal potential.

The soil fertility was determined using the S.O.I.L Fertility Kits supplied from *Forestry Supplier Inc.* for potassium, phosphates and nitrates. Potassium is an important nutrient in the soil because plants use Potassium (K) to help in chlorophyll production and other activities. Nitrates are required in the soil because plants use Nitrogen (N) to make proteins and phosphates are needed because Phosphorus (P) is a source of energy for plant cells. A natural way of adding Nitrogen to the soil is manure. Phosphorus and Potassium can be added to the soil as a fertilizer as well. Nitrogen, Potassium and Phosphorus can also be artificially made and added to the soil.

Soil moisture was yet another protocol that was tested in both sites. Samples of soil were taken at different depth and then weighed, dried and then weighed once again. The soil dry weight was subtracted from the soil wet weight in order to calculate the amount of water in the soil in grams. Then the percentage of water in the soil was calculated by dividing the grams of wet soil by the total grams of water in the soil.

In addition the atmospheric conditions were observed. Current air temperature was tested by using the calibration thermometer. Soil temperature was tested with the surface temperature gun as well as the soil thermometer to sample the soil 5cm down and 10cm down from the surface, done in four times then averaging them. Samples were collected from each horizon and put in a Ziploc bag, labeled with the horizon number, section number and date. Current cloud type coverage was observed using the "GLOBE" cloud chart. In addition the percentage of cloud covers was also observed.

Graphs and Data

Figure 1 Soil Consistency

Figure 2 Soil Color

Figure 3 Soil Fertility

Figure 4 Soil pH

Figure 5 Calcium Carbonates

Figure 6 Soil Moisture

Figure 7 Presences of Organic Materials

Figure 8 Soil Temperature Gradient air, surface, 5cm and 10 cm below the surface.

Figure 9 Percentage cloud cover

Figure 10 Cloud type

Results

The characteristics of the soil in both sites proved to be granular, clay loam soil (figure 1). The soil color in both the irrigated site and the non irrigated sites were slightly different (figure 2). The irrigated soil proved to be higher in nutrients (figure 3). In the irrigated soil the nitrogen levels were low while the potassium was medium on the top part of the soil core but high further down the soil core and the phosphates were medium on near the top of the soil core and low at the bottom of the soil core. The nitrogen levels were the same with a low concentration of nitrogen. The potassium levels increased with depth and the phosphates levels decreased with depth.

In the non-irrigated soil the nitrogen levels had a low concentration throughout the soil core, the phosphate and the potassium levels were medium throughout the soil core.

The pH of the irrigated soil was much lower with a pH range of six to seven while the pH of the non irrigated soil was very basic from eight to nine (figure 4). The Calcium Carbonate levels were very strong in both the irrigated and non-irrigated soil sites (figure 5). The soil moisture content in the irrigated site was 20% higher than that of the non irrigated wooded environment (figure 6). However the non irrigated environment had more organic materials in the form of roots, dead leaves and earthworms than the irrigated soil (figure 7).

The differentiation between the air temperature, surface temperature and the 5cm and 10cm below the surface was much greater in the irrigated grassy site than it was in the non irrigated wooded site (figure 8). This could be due to the fact that the suns rays' heat up the soil faster and then the temperature increases further down you go. When the cloud cover was high the soil temperature was lower when cloud cover was low the surface temperature was higher and there was less moisture in the top of the soil core. Figure 9 and 10 show the percentage of the cloud cover and the cloud type.

Discussion

The results confirmed the hypothesis that the irrigated soil would have more nutrients but it was not predicted that the soil moisture level would be higher in the wooded non-irrigated site. This is most likely due to the fact that the trees shade the wooded site from the suns rays so less water evaporates from the soil. However the non irrigated environment had more organic materials in the form of roots, dead leaves and earthworms than the irrigated soil. The hypothesis was disproved that there would be more organic material such as earth worms, roots and dead plant matter in the irrigated site. There was more organic material in the non-irrigated site; this could be due to the fact that there is a higher level of soil moisture and a greater diversity of plants growing in the wooded no irrigated site.

The hypothesis predicted that the irrigated soil would be much higher in fertility then the non-irrigated soil however the research has shown that the fertility had a slightly higher level in

Appendix J: Sample of GLOBE Certificates

The GLOBE Program

Global Learning and Observations to Benefit the Environment
An International Environmental Science and Education Program

August 22, 2005

Kabrshmoun
Aley,
Lebanon

Congratulations! In the August 2005 determination of the GLOBE Chief Scientist's Honor Roll, Cedars Cultural School has made the Honor Roll in the following categories:

Clouds for the four-month period ending in July 2005

This Honor Roll citation recognizes you and your students for providing measurements of your environment in a way that is particularly helpful for research. On behalf of the GLOBE scientists, the Earth science community, and all who participate in GLOBE, I thank you.

Since taking your first observations on February 7, 2005, Cedars Cultural School has reported data from 911 student measurements. Data have been reported at a rate of 177 measurements per month.

Data reporting is a key contribution to GLOBE. It provides the scientists with what they need for their research; it gives students information to use in their studies; and it indicates to all the continuing success of GLOBE. I look forward to writing you in the future as you continue your contributions to this Program.

Sincerely,

Dr. Margaret (Peggy) LeMone
Chief Scientist

P. O. Box 3000, Boulder, CO 80307 USA (Mailing Address)
3300 Mitchell Lane, Suite 2104, Boulder, CO 80301 USA (Physical Address)
Tel: (1) 303-497-2620 Fax: (1) 303-497-2638

The GLOBE Program

Global Learning and Observations to Benefit the Environment

An International Environmental Science and Education Program

June 22, 2005

[illegible]
Cedars Cultural School
Kabrshmoun
Aley
Lebanon

Congratulations! In the June 2005 determination of the GLOBE Chief Scientist's Honor Roll, Cedars Cultural School has made the Honor Roll in the following categories:

Clouds for the four-month period ending in May 2005

This Honor Roll citation recognizes your school for reporting data in ways and amounts that are particularly useful in scientific studies. Since taking its first measurement on February 7, 2005, Cedars Cultural School has reported data from 757 measurements and has reported data at a rate of 186 measurements per month for 4 months. This is a very good contribution to the GLOBE community of students, teachers, and scientists. In the last two months your school has moved to the 500 measurements rung of the ladder of schools reporting many measurements. This shows that you are a full participant in GLOBE.

On behalf of the GLOBE scientists, the Earth science community and everyone who benefits from this Program, I thank you, your GLOBE teacher, Yosra Jaber, and all participating students at Cedars Cultural School for your good work.

Data reporting is a key contribution to GLOBE. It provides the scientists with what they need for their research; it gives students information to use in their studies; and it indicates to all the continuing success of the GLOBE Program. I look forward to writing to you in the future as your school adds to its achievements in this program.

Sincerely,

I
Chief Scientist

P. O. Box 3000, Boulder, CO 80307 USA (Mailing Address)
3300 Mitchell Lane, Suite 2104, Boulder, CO 80301 USA (Physical Address)
Tel: (1) 303-497-2620 Fax: (1) 303-497-2638

The GLOBE Program

Chief Scientist's Honor Roll

Clouds

Cedars Cultural School

has made the Honor Roll for the four-month periods ending:
May 2005 and July 2005

April 22, 2006

GLOBE Chief Scientist