Judgment of Alignment and Analysis of cognitive learning dimensions of objectives and assessment strategies provided by a selected textbook used in an Environmental Science Course in one high school in Abu Dhabi, UAE.

الحكم على محاذاة وتحليل الأبعاد المعرفية لنتائج التعلم واستراتيجيات التقييم التي يقدمها الكتاب المدرسي المستخدم في دورة العلوم البيئية في مدرسة ثانوية في أبو ظبي، الإمارات العربية المتحدة.

by

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Abstract

This present study evaluated the Environmental Education course using a textbook offered in one of Abu Dhabi, UAE schools as a main reference. The textbook was analysed by judging alignment between learning objectives and assessment strategies using Revised Bloom's Taxonomy as a tool. The research done was qualitative and aimed at classifying the learning outcomes and the different types of assessment into different cognitive learning processes according to the RBT. In addition, knowledge dimension for each item was investigated. The results of the study showed that the textbook was able to provide students with the opportunity to develop their cognitive skills at different levels. This is shown through the assessments provided by the textbook which enabled students to develop their critical thinking and problem-solving skills. In order to have an unprejudiced analysis in the study, objectives and assessments were chosen as only criteria to judge alignment whereas teaching factor was not involved in the study since it can vary tremendously according to situations and learning environments. The study acknowledged the teachers' role and recommended continuous professional development in Environmental education. In conclusion, the study asserted on the necessity of engaging next generation of students in becoming the problem solvers of the emerging Environmental threats.

Abstract

(Arabic)

يرتكز هذا البحث العلمي على تقييم مادة التربية البيئية في احدى المدارس الثانوية في امارة ابو ظبي- الامارات العربية المتحدة وذلك من خلال تحليل الكتاب المستخدم في هذه المادة بهدف الحكم على التوافق بين أهداف التعلم واستراتيجيات التقييم باستخدام تصنيف بلوم المنقح. اضافة الى ذلك، استطاع هذا البحث من تصنيف نتائج التعلم والأنواع المختلفة من التقييم في عمليات التعلم المعرفي باعتماد اداة التصنيف المنقحة من بلوم. وتناول التقييم ايضا بعد المعرفة الخاص بكل بند من الكتاب موضوع هذا البحث. وأظهرت نتائج التقييم أن الكتاب المدرسي المعتمد قادر ان يزود الطلاب بفرصة لتطوير مهاراتهم المعرفية وذلك على مختلف المستويات، وان التقييمات المقدمة في الكتاب يمكنها تطوير مهارات التفكير النقدي ومهارات حلّ المشاكل عند الطلاب. من أجل إضفاء الموضوعية على التقييم والتحليل، تمّ اعتماد معايير الأهداف والتقييمات كمعايير وحيدة للحكم على المواءمة في هذا البحث نظراً لأنّ عامل التدريس عاملاً ديناميكياً يختلف بشكل كبير وفقا للحالات. اضافة الى ذلك، اشاد البحث بالدور الكبير الذي يلعبه المعلمون الثانويون في العملية التعليمية وأوصى بضرورة اعداد برامج تطوير مهني مستمرة في التربية البيئية. في الختام، أكد البحث على ضرورة تمكين الجيل القادم من الطلاب من عمليات التحليل النقدي وايجاد الحلول للمشاكل الناشئة عن التهديدات البيئية.

Dedication

I dedicate this work to:

My **Father's soul** who was an example of continuous ambition and achieving success.

My **Mother** who dedicated herself to support her young boys in all fields especially in the field of Education.

The **Love of my life, my wife** who is a continuous source of inspiration and support especially throughout this work.

My **two brothers** who are a continuous source of encouragement.

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I would also like to commemorate Dr. Clifton Chadwick as I remember his support and the sense of humor he had when I took management courses under his supervision. May his soul rest in peace.

Finally, I want to express my very profound gratitude to my parents and to my spouse, for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them.

Table of Content

Chapter 1

1. Introduction

Sheikh Zayed Bin Sultan Al Nahyan said “On land and in the sea, our fore-fathers lived and survived in this environment. They were able to do so because they recognized the need to conserve it, to take from it only what they needed to live, and to preserve it for succeeding generations” (Gulf News 2005) but unfortunately on the other hand, we find another quote saying “Our biggest challenge in this new century is to take an idea that sounds abstract - sustainable development - and turn it into reality for all the world's people” (Annan, 2001) which shows how much humans misuse their environment.

Human factor is the largest contributor to the environmental degradation and their behaviors are the main source of environmental problems, exposing their lives and the live of all the living species on earth to serious health threats. Sadly, People who have negative attitudes towards nature appear to be blind to environmental problems. In this dramatic situation, education about the environment, compiled with human rights, citizenship, ecology, aesthetics, ethics and democratic education, become essential to improve sensitivity and knowledge of nature and to promote radical changes in human’s attitudes and behaviors by creating a person who is able to react against nature’s problems, suggest solutions, participate actively, think, argue, question, able to comprehend and adopt sustainable life and development, and be in tune with the world’ (Yousuf & Bhutta 2012).

1.1 Purpose and objectives

The main objective of this paper is to investigate the alignment between learning outcomes of Environmental Science course and the assessment strategies presented in the textbook used in the American curriculum in one of Abu Dhabi schools. The textbook titled "Environment, The Science behind the stories" was chosen since it is the only textbook used for instruction in this course.

The paper will discuss as well:

- The importance of Environmental Education (EE) at different academic levels, at local and international level in an attempt to prepare the next generation of learners to be sensitive toward environmental threats and to find appropriate and effective solutions to environmental problems.

- The importance of the contributions of the education system, schools, teachers, curricula and textbooks in guiding the EE.

1.2 Research questions

The main focus of this study is to judge the degree of alignment between learning outcomes and assessment strategies provided by the textbook based on Bloom's taxonomy tool. In addition to an overview of the fitness within the cognitive level of the learning process, curriculum items will be analysed in order to show how well they develop critical thinking and problem-solving skills among students. This research study will address the following questions:

- Is the Environmental science textbook "Environment, The Science behind the stories" used for high school students showing alignment between the learning objectives and the assessment provided at the end of sample chapters?

- Is the Environmental science textbook "Environment, The Science behind the stories" a good instructional and referential tool to use in order to help students become long-term learners and develop critical thinking and problem-solving skills?

1.3 Rationale for the study

Environmental attitude among school students differs from a country to another. In general, students tend to show and express their concern toward environmental issues, have positive environmental attitudes and are willing to protect the environment but unfortunately, they suffer from an inadequate or even a lack in environmental knowledge (Yousuf & Bhutta 2012; Makki, Abd-El-Khalick &Boujaoude 2003). Therefore, schools play a significant role in the environmental formation of their students and educating students about the environment appears to be very crucial. Many actors seem to play a major role in raising the level of sensitivity and the degree of environmental awareness and responsibility among students: the student population, their family background or prior achievement; the enthusiasm, experience and competence of the team of teachers; the curricular offering; the quality of instruction; and the social climate (Haury 2002). Due to the important role that EE is playing in the process of sustainability and preservation of natural resources, the United Nations (UN) has designated in Johannesburg World Summit 2002, the period 2005 to 2014 the "decade of Education for sustainable development" (Pro Europe, 2005, Promoting a sense of responsibility through environmental education in Environmental Education: the path to Sustainable Development, p.5). Since then, many governments have taken the initiative of integrating environmental concepts in their formal education and adopting national curriculum framework that addresses environmental subjects (Yousuf & Bhutta 2012).

The major goal of EE is "to aid learners in becoming environmentally knowledgeable and, above all, skilled and dedicated human beings who are willing to work, individually and collectively, toward

achieving and/or maintaining a dynamic equilibrium between the quality of life and quality of the environment" (Harold et al. 1994). Baring this goal in mind, EE curriculum has to provide students "[…] with experiences in environmental problem-solving skills such as problem identification, evaluation, and implementation of environmental actions (issue resolution)" (Harold et al. 1994).

Changes in science and education and specifically the reorientation of the Education toward environment sensitivity and protection becomes a must in all countries. Schools and teachers at all levels are invited to ensure that students, the citizens and decision-makers of tomorrow, are acquiring the necessary knowledge and skills to engage in better environmental practices and problem-solving. Baring these objectives in mind, this study will explore EE in the United Arab Emirates (UAE) by focusing on the environmental science course offered by the high school American curriculum program in Abu Dhabi - UAE and checking the learning outcomes and assessment provided by the textbook used for this study.

Chapter 2

2. Literature Review

2.1Conceptual Analysis

2.1.1 Historical importance

This study investigates the alignment between learning objectives and assessment strategies of environmental science course in the American high school curriculum used in one of Abu Dhabi main schools. The examination of this course is essential for addressing the situation of EE in Abu Dhabi and the degree of environmental sensitivity acquired throughout the learning process. To do so, an overview on the EE throughout the history will be addressed at a glance.

In fact, EE became internationally recognized during the Conference on the Human Environment that was held in Sweden in 1972. Following it, a global framework for EE, the "Belgrade Charter" was proposed by The United Nations Educational, Scientific, and Cultural Organization (UNESCO) as a response to the major emerging environmental problems. It aims at developing "a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones". (UNESCO- UNEP 1975)

The definition of EE came out by UNESCO through the world's first Intergovernmental Conference on EE that was held in Tbilisi, Georgia, USSR in October 1977. The Tbilisi Declaration was formulated during this conference pointing out on fundamental EE goals figured as "a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO, 1977).

It is therefore an essential part of the sustainable development that humans must incorporate in their behaviors toward the ecosystem they are living and interacting with. In this context, and as mentioned in the Excerpts on EE From Belgrade Charter, teaching about EE became an international agenda triggering mostly all nations, at both governmental and individual levels, to adopt it and to integrate it in many disciplines from Biology to Chemistry, Physics, Ecology, Earth Science, Atmospheric Science, Mathematics, Geography, Economy, Law… Both the Formal Education Sector consisted of preschools, primary and secondary schools, high schools and universities and the Non-Formal Education Sectors at individual and collective levels were concerned and with the full participation of all age-group and segments of the population.

As mentioned during the United Nations Conference on Environment and Development (UNCED), Principle 36 of the Agenda 21 emphasized on "unanimous agreement among developed and developing countries alike that education was critical for promoting sustainable development and increasing the capacity of the people to address environment and development issues" (UN, 1992). And since then, many UN Conferences were held worldwide. The Conference on Environment and Development (Rio, 1992); The Human Rights Conference (Vienna, 1993); The conference on Population and Development (Cairo, 1994); The Conference on Social Development (Copenhagen, 1995); Women Conference (Beijing, 1995) and the Conference on Human Settlements (Istanbul, 1996), as well as the nineteenth special session of the United Nations General Assembly (1997), all emphasis on the necessity of education and public awareness on both national and international levels.

2.1.2 Differences and similarities between Environmental Education, Education for Sustainability and Education for Sustainable Development.

Environmental science course may represent different purposes and aims which should affect students in a positive way and make sure that it provides them with enough tools to face the challenges of tomorrow. This chapter explores the different approaches that exist when dealing with environment in the education field. The terms 'Environmental Education' (EE), 'Education for Sustainability' (EfS) and 'Education for Sustainable Development' (ESD) are used interchangeably in the literature. They generally refer to "the knowledge, skills and values which students are expected to learn to enable them as graduates working in business, government and society to progress towards more sustainable ways of living and working" (Chalkley 2006).

In 1987, the World Commission on Environment and Development or the Brundtland Commission introduced the concept of sustainable development (SD) to support economic and social development, in particular for people with a low standard of living and to underline on the importance of protecting the environment and the natural resource base and the environment. Three equal dimensions are the basis of sustainability: social equality, ecological compatibility and economic efficiency (Pro Europe 2005, Promoting a sense of responsibility through environmental education in Environmental Education: the path to Sustainable Development, p.5).

Due to the fact that economic and social well-being cannot be improved with measures that destroy the environment, international solidarity becomes crucial and education became since, a global agenda. In this shadow, The UN Resolution 57/254 declared the period 2005-2014: The Decade for Education for Sustainable Development starting in 2005 illustrating the importance of education in achieving sustainable development and the drafting of a UNECE strategy for education for sustainable development was initiated in May 2003 (Bärlund 2004).

As defined, EE constitutes a core component of ESD and ESD emerges as one of the main pivotal actors of sustainability together with legislation, economy, socio-culture and technology. Nevertheless, differences between EE and ESD were explicitly noted in UNESCO's ESD Sourcebook. In this light, KACEE defined EE as a process directed at creating awareness and understanding about environmental issues that leads to responsible individual and group actions (KACEE 2010) whereas, Sun sees EE as a discipline in itself that is different from ESD which goes beyond EE to embrace broader dimensions (Sun 2014). Thus, "ESD teaches all the spheres of sustainability – environment, society, and economy, with an underlying dimension of culture… [Whereas] EE focuses more on the environment [;] […] ESD has four thrusts: (1) access to and retention in quality basic education; (2) reorienting existing education programs, (3) increasing public awareness and understanding; and (4) providing training … [whereas] EE primarily works in thrusts two and three" (UNESCO 2012). In this context, teaching ESD will help in dissolving the artificial boundaries between the environment, economy, and society and as mentioned in the framework of UNECE Competencies for ESD teachers: "[EE] emphasizes environmental problems, but if teachers have the intention to take the issue of sustainable development seriously, they will also link the issue to the economic, social, cultural and political aspects" (UNECE, 2008 p.23).

In parallel and during the last few decades, ESD and Climate Change and Environmental Education (CCEE) have become major tools for protecting the environment and ensuring sustainable development (Iltus 2012). Development Education (DE) seeks to develop strategies to increase teachers' understanding of the social aspects of climate change. In addition, it provides the framework for a child-centered participatory approach to environmental awareness and nature that can be incorporated into the design and operation of the school curriculum.

Furthermore, DE plays a key role in developing knowledge of global environmental issues through active, inclusive, participatory learning and teaching processes (Department of Foreign

Affairs, 2006: 12). The dynamic relationships between EE, DE and ESD was done by O'Malley. She found out that closely aligned to the aims values and outcomes of DE, EE seeks to address global environmental issues through informal and formal education (O'Malley 2015).

2.1.3 EE and ESD in Science Education, Curriculum and teaching methodologies

Teachers are always the building block in any success or failure related to a certain field. Although we are not discussing the teachers' role in this study, we will mention the way they can be effective between learning objectives and assessment strategies. Actually, they are responsible to create, apply and enhance learning outcomes through a keen evaluation of results of assessments that should be aligned with the learning outcomes. As reported by Auwal Rabiu A. (2015), the knowledge of the teacher must be reflected in the behavior of their students. He asserted that Rural students appeared to have low level of environmental awareness found in rural students can be attributed to the improper guidance that these students are receiving from their teachers.

O'Malley asserted that despite the existence of a broad range of EE studies, "the lack of diversification and prevailing quantitative evidence has led to fragmentation and repetition in the field and more cognizance needs to be taken of children's actual experiences" (O'Malley 2015).

Historically, and as the Handbook of Research on Science Education mentioned and as reported in Hart's study, EE and Science Education have shared a natural linkage. In fact, the roots of environmental issues are sciences and environmental problems and environmental concerns were widely discussed in sciences such as ecology, conservation biology, environmental geology, and green chemistry. Many examples of environmental and science education curricula exist to provide students with an up-to-date information about the myriad of environmental issues and from a variety of scientific disciplines.

Nevertheless, and as noted by many researchers in the field of EE, old curricula that only emphasis on disseminating scientific information appear to be not enough in addressing environmental issues. The historical focus of EE on respecting nature alone appeared to be unable to change destructive behaviors. Educators feel responsible for providing information about the environment but do not see themselves in the role of changing long-term behaviors.

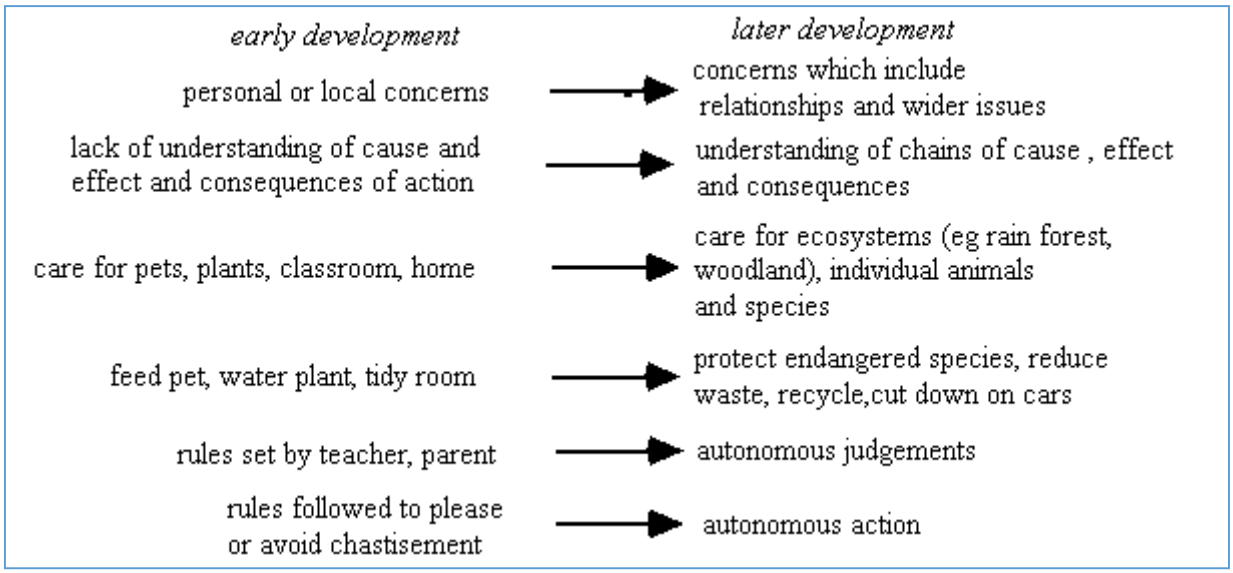
In their examination on the Turkish curricular, Özmen and Karamustafao found that the relation between human and environment is handled superficially in the present textbooks and the importance of the environment on the human life as well as the factors causing environmental pollution are not mentioned sufficiently (Özmen H., Karamustafao O. 2006).

In their studies, Blumstein and Saylan reported the disconnection that exists between EE and personal responsibilities: unfortunately, people have failed to make the link between their individual actions and the environmental issues surrounding them. Their article asserted that a large impact on our environment will be achieved if environmental education program, from kindergarten till 12th grade, are designed to allow proper evaluation with before-after treatment-control designs, focuses on changing the over-consumption practices and the profound unsustainable footprints on the global environment. Teaching with a "World View… [Approach] [,] [focusing] on appreciation of the diversity of cultures and peoples" (Blumstein and Saylan 2007) should help realizing the selfish "Not in my backyard" unsustainable practices toward the environment and changing behaviors toward the conservation of consumable products especially food, clean water, energy and the global climate change. Teaching critical thinking is a must and with the conceptual tool kit, students' ability to ask questions, to identify assumptions, and to make well-reasoned decisions and thus become environmentally aware citizens can be achieved.

Similar results were obtained in Littledyke's study in a primary school. LittleDyke found that children's understanding of science was mainly limited to their experience of the subject at school

(Littledyke 2002). Understanding of the term 'environment' differed from younger children to the older children. Figure 1 represents her illustration on "the key aspects of the changes, which can occur in environmental cognition and moral development in children" (Littledyke 2002). She pointed out on the need for the systematic inclusion of EE within the science curriculum and the need for its identification as a cross-curricular theme. Choosing topics which are relevant to students and that foster their understanding that science, as a process of learning, has cause and effect that can be beneficial but also destructive are needed.

Figure 1: The Key Aspects of the changes, which can occur in environmental cognition and moral development in children. (Adapted from Littledyke, 2002)



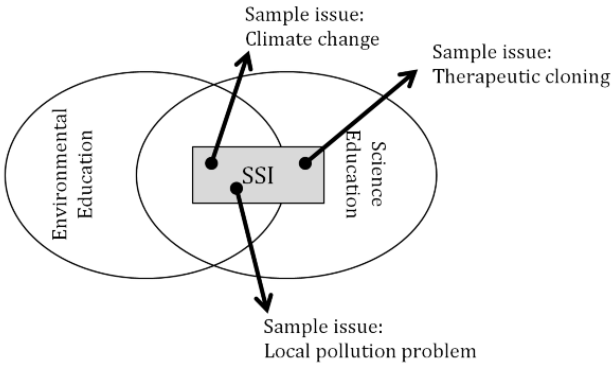
Source : Available at : http://www.leeds.ac.uk/educol/documents/00002338.htm

Children appear to be active agents in "creating their own cultures and life world" and they tend to learn and develop their attitudes toward the natural environment through socialization processes (O'Malley 2105). Finding the balance between rational and humanistic approaches is yet

required when addressing environmental issues. Accordingly, environmental moral issues and social impact on ecosystems must be taking into account while teaching EE. Curriculum Educators must work in developing curricula and incorporating lessons that tackle behavioral decisions toward the environment in order to improve students' decision-making skills and consequently help students become environmentally sensitive.

Sadler and Murakami, and as shown in Figure 2, used a simple Venn Diagram to illustrate the relationship between EE and Science Education and the overlap that exists between them. Furthermore, their diagram shows the Socio-scientific issue (SSI) based teaching and learning, a newly emerged movement within the field of science education, that allows student to engage with science and especially with environmental issues "that matters beyond classroom walls" (Sadler 2014). Sadler gave many examples of SSI in classroom based projects for EE. Projects that can vary from global environmental issues such as the subject of climate change to local environmental issues such as the subject of pollution problem were mentioned by many authors (Evagorou 2011).

Figure 2: A graphic depiction of the relationship between environmental education, science education and socio-scientific issues based teaching.



In fact, SSI-based teaching methodologies will help students, the citizen of tomorrow, understand the important contribution that environmental and science education can add to the field of democracy, citizenship and social justice. Socio-scientific issues rely upon scientific knowledge, reasoning and the ability to negotiate evidence in order to take decisions. Students are invited to reflect on their own beliefs and defend their opinions during the process of learning the environment. This approach is boosted when students are encouraged to develop high cognitive skills that will be discussed later in this study.

Understanding how students think regarding the moral and ethical context of socio-scientific issues in general and environmental issues in particular, will allow science teachers to acquire and incorporate teaching strategies aiming at developing students' reasoning skills in these crucial areas. These findings were reflected in the investigation on the "relationships between students' conceptions of the nature of science and their reactions to evidence that challenged their beliefs about socio-scientific issues" (Zeidler et.al 2002). These researchers have found that students' reactions to anomalous socio-scientific data are varied and complex. Conceptions of the nature of science were being reflected in students' reasoning on a moral and ethical issue and notable differences in the reasoning processes between high school students and college students were reported.

Zo'bi, in his attempt to 'identify nature of students' decisions patterns towards environmental issues and the possibility to improve these decisions during teaching process using Socio-Scientific Issues Approach at the university level (Zo'bi 2014). He found that the SSI Approach enhanced students' ability to improve their own decisions regarding environmental issues and he was able to classify students' decisions into four patterns: The first pattern is based on wrong understanding of scientific concepts and their applications, the second on logical linear (formal) decisions taking into account few limited dimensions, the third pattern consists on decisions on a limited level of controversy. Issuing decisions includes scientific thinking and takes into account the integrated

comprehensive dimension. Thus, and in light of these results, paying attention to the SSI Approach emerges as an essential axis that EE educators must take into account when teaching scientific concepts and must be trained on using it.

However, and as asserted by Sadler and Murakami (2014), significant challenges exist in achieving the SSI- based- teaching and learning in schools and in particular in the process of developing SSI-oriented curricula and materials and the implementation of SSI learning experiences in the classrooms. But despite these challenges, the socio-scientific issues-based teaching approach is still recognized as the ultimate approach that allow teachers to integrate the social aspects (moral, ethical, economic…) and the individuals' or groups' perspectives toward environmental problems into their classrooms.

As quoted from Klosterman and Sadler, and as cited explicitly in the website of Science Education Resource Center (SERC) at Carleton College: "students will not be able to solve the issue of global warming, however they will be able to develop a position based upon the research they discover as they explore the issue and learn science" (Klosterman and Sadler 2010). However, in order for the teaching and learning to be relevant, the learning activity framework must be articulated on interdisciplinary problem based approaches that respect the balance between cognitive, psychomotor and affective domains.

Needs assessments and expected competencies outcomes are the promoters of curriculum design and development (Dambudzo 2014). Harris, Mishra and Koehler (2009) identified technological, content and pedagogical knowledge as components of effective teaching and Dambudzo (2014) asserted the role of learner-centered approaches encouraging problem-solving, critical thinking in ESD. Positive changes in students' environmental attitude receiving a project-based learning approach were observed by Murat (2015). These positive changes included enhancing

creativity and acquiring a permanent learning in students, as well as students found themselves being able to do more researches and to find better solutions to the environmental problems.

Successful experiences of countries applying the integrated teaching approach in their education systems were noted. This approach allowed teaching based on both philosophy and practicality while "drawing together knowledge, skills, attitudes, and values from within or across subject areas to develop a more powerful understanding and linkages of key ideas" (Mwenda 2017). Collective responsibility and critical-thinking skills to solve environmental complexities "percolate throughout the school day, from history lessons to literature analyses to disputes on the playground" and teachers from upper-level science, middle school and preschool classes "can meet outside to delve into environmental causality" (Shafer 2015).

2.2 Theoretical Framework

2.2.1 Overview on environmental topics in some countries' High School Curriculum:

The importance of this study lies in its investigation on the EE efficiency in making students becoming more aware about the threats that face the environment and the responsibilities they must develop in the future towards their environment. In this chapter, we overview the different approaches taken by different countries at the level of school, governments, NGO and other stakeholders in order to spread this awareness among the new generation. In order to achieve EE, many countries and environmental Non-Government Organizations (NGOs) have developed curricula and active programs that emphasize not only on EE but on ESD as well. In this context, we mention the support of International bodies and programs, such as UNESCO, UNEP, the Japan- U.S Common Agenda and the Environmental Congress for Asia and the Pacific (ECO ASIA) in developing an Environmental Education Project (EEP) with a regional strategy and an international network in Asia and the Pacific region. However, some countries are still facing challenges in the process of

developing their EE strategies; economic development, lack of government commitment to integrate EE into the formal education system are noted in addition to weak competency and capability of teachers, conventional teaching methods and rigid curricula (IGES 2001). Efforts to integrate environmental themes in social science, liberal arts and the humanities curricula have been made by some countries while others are still teaching environmental topics in their physical science and geography classes.

The Russian EE is interdisciplinary and problem-focused and is delivered at the boundaries between the natural sciences and the social sciences. Depending on their anticipated future work, universities students are trained in several specialties: General ecology, geo-ecology, nature management, sustainability, prevention, environmental, economic, social… As cited in The Reforms in Russian Higher Education's report, Environmental education at university level in modern Russia has four principal roles or spheres which are interconnected and of equal importance. These roles as they figured in the report are quoted as follow:

"the propagation of ideas and information about environment protection, conservation and sustainability; the promotion of civic discourse and the methods by which the public can participate meaningfully in essential community decisions requiring sustainability knowledge; the development and dissemination of specialized, problem-focused knowledge and resources required to underpin the training of professionals active in environmental careers; [and] the preparation of elementary and secondary teachers, university-level faculty and wider staff in the field of environmental education." (Kasimov, Malkhazova & Romanova 2015)

In Europe, the Green Dot organizations have been working on developing methodical education approaches with programs and materials intended for EE in schools curricula. Educational programs include learning about sorting, recycling and packaging waste, protecting natural resources and lowering CO2 emission and many other environmental subjects (Pro Europe 2005). More than

170,000 children in 1600 schools across Europe are using their environmental guides. Many educational establishments across Europe have joined the Green Dot project.

In Canada, a policy framework for EE in Ontario schools, 'Shaping Our Schools, Shaping Our Future', was published in June 2007 to support EE policy in schools and to teach environmental literacy (Ontario Ministry of Education 2011). This framework tackled the importance of changing individual behaviors and organizational practices by defining goals and processes according to local country communities while taking into consideration the global environmental approach and concepts. As mentioned in this framework, an integrated approach to environmental education was needed to "encourage[s] targeted approaches to professional development, emphasizes community involvement, and provides models for guiding implementation and reviewing progress" (Ontario Ministry of Education 2009). Accordingly, the Ministry of Education has issued standards for EE in the Curriculum to be used as guide in curriculum design and revisions. These standards provide students with the knowledge, perspective, skills and practices to develop environmental literacy and critical thinking skills for the purpose of understanding the interaction between the human and the nature system, increasing of their sense of local and global citizenship and engaging them in implementing protection, conservation and sustainable behaviors (Ontario Ministry of Education 2006). Tips, techniques and resources as well as project ideas and activities from Ontario schools and boards were put at the disposition of schools to engage students in their classroom in researches and to contribute in building their EE. We cite some of these ready-made resources like IDEA BANK: Successful Practices A collection of practices from Ontario schools and boards, MINDJOGGER: Put on Your Creativity Glasses (Ontario Ministry of Education 2009)

In USA, Kindergarten through 12^{th} grade curricula include EE modules. Environmental educators who work in the private sector provide highly extra-curricular activities to school districts. But as mentioned in the 2005 Annual Report to Congress, an update of the National Environmental

Education Act that was enacted 15 years ago is needed in order that the National Environmental Education Act for the 21st Century could "[to] reflect the growth and maturation of the environmental education profession" (The National Environmental Education Advisory Council 2005, p.4), actively engage all society sectors by making EE materials more accessible and allow teachers to enroll in assessment-based professional development programs to improve their teaching capabilities.

For example, the California Education and the Environment Initiative (EEI) high school curriculum teach critical skills in science and history-social science using environmental topics. It includes units covering the Greenhouse effect on natural systems, ocean Currents and natural systems, rainforests and deserts and Human Influences, the life and times of carbon, the ozone layer and the ultraviolet radiation and water as a natural resource. EEI high school biology curriculum includes units on Genetic Engineering and the environment, biodiversity, ecosystem change, differential survival of organisms, biological diversity and the isolation of species (California Education and the Environment Initiative 2016).

Notwithstanding with the fact that India has become one of the fastest progressing countries in the world in addressing environmental issues, improving the quality of education are still needed in the country in order to increase literacy rate, sensitizations and environmental practices especially among college students. In addition, recommendation to improve environmental quality and adopt various international and national strategies such as Environmental Courts, Environment Friendly Products, Solar Energy Commission and others strategies are still needed (Sivamoorthy et al. 2013). Developing countries lack legal and economic framework that support sustainability and protection behaviors among the general public despite "growing awareness of all levels of society, including governments, general public and the scientific community" (Sivamoorthy et al 2013). The mandatory incorporation of environmental education for all the students irrespectively of their curriculum to increase environmental awareness and practice was made all over India and school and college

awareness regarding problems such as famines, droughts, floods, scarcity of fuel, firewood and fodder, pollution of air and water, problems of hazardous chemicals and radiation, depletion of natural resources, extinction of wildlife and dangers to flora and fauna are increasing. Although the level of awareness in students is high, recommendations of researchers stressed on the need to improve the quality of education and include social dimensions and 'actions towards creating environmental awareness and environment friendly practice among the college students' (Sivamoorthy et al. 2013). Researchers asserted as well on the necessity of teaching all students irrespective of their gender. More practical oriented programs are needed in India and suggestions to sensitize students by celebrating special days 'like world environmental day, wildlife day, world water day, forest conservation day are of wide benefit. To complete the figure, NGOs, social activists, government and Social Work Professionals need to support EE by undertaking scientific researches and explore more environmental aspects.

2.2.2 EE in UAE K-12 Education

Since our focus is on the UAE situation, we will overview as well the approaches taken at different levels in order to spread awareness among the future UAE generation. In fact, we noticed that EE in UAE is enacted through a variety of local, national, and international programs. Since 1999, The Ministry of Education having as objective to increase student environmental awareness initiated an enrolment of governmental and non-governmental schools' students in international environment programs and projects. Among these environmental initiatives, we cite the Organic Farming Groups Initiative (Horticulture) that promoted organic farming and corps observation among 54 schools of various academic grades and The Global Learning and Observation to Benefit the Environment (GLOBE) science and education program that targeted approximately 54 primary and secondary governmental schools, to link students with the GLOBE international website and research

network in order to contribute in GLOBE environmental activities and to "[…] to carry out research and studies in order to help solving the environmental problems that the country's regions face" (Maryam Husain Salem Mohammed Al Refaei M. 2014).

Government-led initiatives programs fostering environmental education like Enviro-Spellathon, the Sustainable Schools Initiative and the Sustainable Campus Initiative and Zayed Future Energy Price engaged many school across UAE in environmental awareness. The Environment Agency - Abu Dhabi (EAD) in conjunction with the Emirates Wildlife Society and partners, launched for the academic year 2008-2009 an environmental education program, the Enviro-Spellathon program. Primary schools across the United Arab Emirates, incorporated six booklets or 'levels' covering themes pertaining to the UAE environment such as wildlife, water and waste to promote proper environmental behavior. Children aged 6–12 years were examined after studying these booklets and depending on their exam scores, gifts and certificates were received. Since its inception in 2001- 2002, Enviro-Spellathon program had already engaged over 545 government and private schools and educated school children between the ages of six and 13, and "[…] has been hugely successful in evoking the interest of children through enjoyable study materials and activities that illustrate the vast variety of plant and animal life that exists within the UAE" as Majid Al Mansouri, Secretary General of EAD reported to Gulf News Education Section.

The United Arab Emirates' (UAE) Sustainable Schools Initiative, or 'Al Madaris Al Mustadama', was designed to reduce the ecological footprint in UAE. This initiative was very successful and schools that were involved in the program have demonstrated a concrete reduction in their ecological footprint. In 2014, the Environment Agency – Abu Dhabi, launched as well the Sustainable Campus Initiative to strengthen and build leadership capacity among university students.

In 2015, the National Environmental Education & Awareness Strategy 2015 – 2021 was launched. It includes as first goal to 'Educate youth to drive the UAE towards a sustainable future' by adopting a clear strategy to raise environmental awareness amongst UAE school, university and VET students by implementing the following initiatives and programs:

- Work with the Ministry of Education to ensure inclusion of the UAE's environmental priorities in the new MoE K-12 school curriculum, and coordinate the development of teaching and learning material;
- Encourage private schools to formally integrate environmental education into their curriculum;
- Develop and rollout national voluntary programs supporting schools, universities & VET institute campuses sustainability;
- Incorporate environmental education into teacher training and professional development programs;
- Assess the feasibility, develop and rollout a framework for incorporating sustainability into university courses for key majors;
- Assess feasibility of incorporating sustainability into vocational training and use a selected vocational institute as a pilot.

In addition, the Environmental Awareness Section in the Environmental Department of Dubai Municipality has targeted various society segments in Dubai by promoting environmental cultural programs and activities, environmental lectures, workshops and exhibitions to achieving social awareness and responsibility towards the environment in Dubai. They contributed in many specialized environmental exhibitions, such as the 15th Water, Energy, Technology, and Environment Exhibition (WETEX), the Water Future Energy Summit 2013, the What Works Science Forum Exhibition held at Zayed University Conference Center and many others. The future generations were targeted as well by over 140 lectures and workshops and by many exhibitions in the

public and private schools, universities, public libraries, summer centers and clubs in Dubai. Brochures, stickers, books, booklets and cultural magazines in addition to coordination of school cleaning events are organized each year. The Environmental Awareness Section in the Environmental Department of Dubai Municipality has also incorporated measurements of public awareness and ethics towards the environmental issues are in her strategic plan. The municipality reported on her website, that public environmental awareness level reached 73% in Dubai in 2013, while public environmental ethics reached 82%. Moreover, the Section has evaluated more than 17 environmental researches submitted by national participants and 22 environmental researches submitted from the Gulf Countries under Sheikha Latifa Award for Childhood Creativity.

It is good to mention that, as part of the Dubai 2021 plan to make Dubai a smart and sustainable city, the "My City. My Environment" campaign launched in 2015 was implemented in schools via workshops, activities and hands-on-experience to teach children about the importance of recycling and reducing waste. The initiative succeeded in creating green actions with measurable impacts. In fact, recycling cubes – one for aluminum, one for paper and one for plastic – were placed in schools, children were invited to collect in these boxes recyclable items and rewards were envisaged at the end of the school year in order to teach students about the value of their contributions in terms of money, objects and/or rewards. These Mega Cube were also displayed in public parks and shopping malls as part of this green campaign.

2.3 Review of related literature

Bearing in mind the objectives of this study, an overview on other researches' work is highlighted in this part. In fact, many studies discussing the degree of alignment between objectives and assessments were previously done but mainly these studies focused on other science courses. These studies discussed as well the role of instruction in such alignment.

Grossman and Cawn (2016) discussed a case study about aligning math curriculum to common state standards. The case study is done in DC Bilingual Elementary Charter School in Washington, D.C. and described the process of alignment of the curriculum. The assessment showed that the alignment succeeded in improving the level of student's achievement; the proficiency of students increased by 30 points in reading and by more than 60 points in mathematics. They concluded that the continuous alignment makes the performance of students becomes better with years.

Nasser et al. (2014) inspected the degree of alignment between curriculum developed by teachers and the national standards in Qatar. Their investigation used different approaches like questionnaires and interviews in addition to expert ratings of the material developed by teachers in order to measure the roles of teachers as well as their methods in curriculum development. The expert roles in this study was crucial in measuring the alignment of objectives and activities with the standards used. The study confirmed the alignment of Arabic, English, Math and Sciences standards with their tasks. Their investigation checked as well the scope, the developmental level, the content and cognitive level which appeared to be satisfactorily aligned. The only misalignment was shown at the level of assessments that appeared to have a severe lack at the cognitive level. Their study showed as well necessary needs in reconsidering the professional development and the reform policies in the country.

Näsström 2008 investigated the usefulness of models used in alignment analysis between learning outcomes and assessment strategies and focused mainly on RBT (Revised Bloom Taxonomy). His investigation deeply explored the different methods of alignment analysis and applied RBT to investigate the alignment in mathematical concepts. Gunilla succeeded in proving that Bloom's taxonomy was the best model to be used and the most useful one and reached furthermore to the conclusion that RBT is the most useful for analysis and that it can be an alignment model. But the limitation of his study was the absence of investigation on the ability of the RBT model in enhancing enhance the alignment in practical term of view.

Smith (2012) focused on learning objectives and assessment of the science curriculum in a middle school in Australia. His study designed and evaluated a model of assessment of the alignment between different building blocks of the curriculum. He observed that the curriculum was not able to help students in developing their skills in terms of science knowledge although this objective was explicitly mentioned in the intended form. He assumed in his hypothesis the presence of a misalignment of objectives with the designed assessments but his case study showed at the end the presence of a certain degree of alignment. Analysis of curriculum materials from two different science courses by using scoring was able to indicate the presence or the absence of alignment. In addition to scoring data analysis, interviews supported the evaluation model used.

Multiple examples tackling different approaches about alignment between objectives and assessments exist in the literature but mainly these examples were applied to subjects other than Environmental Sciences. Due to its importance of Environmental Sciences at the global level and its positive implications on the future of our environment and our earth, this study will try to fill this gap by applying RBT analysis on Environmental science course.

2.4 Theoretical consolidation

2.4.1 The cognitive level of Environmental Education

Alignment between learning objectives and assessments and especially those targeting the higher cognitive level according to Bloom's taxonomy will end in preparing a generation that is aware of the threats affecting the environment and will succeed in making our students the critical thinkers and the problems solvers of tomorrow. Applying this to EE, we must consider the outcomes of the

alignment between learning objectives and assessments on students at the different levels of education especially in linking them positively to the environment and its threats.

Indeed, learning objectives and assessment strategies will help in evaluating where we stand according to the development of cognitive skills and knowledge dimension in this specific study. To do so, this study will only focus on the textbook chosen. In this chapter, an overview on the importance of EE and the approach that education stakeholders are taking in order to enhance student's sense of belonging to the environment.

Unfortunately, it is claimed that modernization is leading to "children's growing disconnect with the natural environment and children lack important outdoor experiences and are ill-equipped to develop the necessary skills to prevent further environmental damage" (O'Malley 2015). Data of Norwegian secondary students (age 15) collected through the Relevance of Science Education survey (ROSE survey), an international comparative research project on affective factors of importance to the learning of science and technology (S&T), found that students are moderately engaged in the environmental issue and show little curiosity about finding solutions to them (Schreiner & Sjøberg 2004). In parallel, worldwide studies have shown that the level of environmental awareness among secondary school students is in general low with a significance difference related to age group.

The location of the school did not seem to have any effect on the level of environmental awareness of students (Auwal Rabiu 2015) but gender differences in the perception of people towards forest utilization, degradation and conservation was noted. These differences were attributed to the gender role socialization transmitted from one generation to another, making human race the primary destroyers of the forest while women are seen as secondary users of the forest (Omoogun & Odok 2013).

In an attempt to explore the connection between children and the environment, Burgess and Mayer Smith tried to understand how nature experiences arouse 'biophilia' or 'a love of life and all

living things' in children. By evoking the findings of previous empirical researches on how humans and nature are biologically connected, they found that '[…] contact with the natural world, especially during middle childhood, occupies a very important place in the child's emotional responsiveness and receptivity. Unfortunately, and as Burroughs affirmed, "Nature lore is a mixture of love and knowledge … [and]… knowledge without love will not stick [;] but if love comes first, knowledge is sure to follow" (John Burroughs, 2000). Thus, promoting a fruitful union between the environment and children in particular, biophilia requires "… [to be] cultivated through the blended growth of environmental knowledge, emotional responsiveness, physical connectedness, and aesthetic appreciation of nature" (Burgess & Mayer Smith 2011).

Consequently, educators can make use of the biophilia in children to explore educational reform and to shift the emphasis of school-aged children toward "[…] a heartfelt affiliation for life and a love affair with the natural world" (Burgess & Mayer Smith 2011). In fact, a significant change in the perception, awareness and sense of responsibility toward the environment was reported among youth students receiving EE teaching (Grimmette 2014). Grimmette reported that "[…] [youth] became aware that animals contribute to the well being of humans and humans can greatly affect the well being of animals". The Allensbach survey conducted in Germany in 2002 had as well confirmed the positive effect of EE in increasing the interest of their students and their knowledge regarding the environment (Pro Europe), 2005, Green Dot – promoting environmental awareness and motivating people, p.11 in Environmental Education: the path to Sustainable Development).

As argued by Schreiner & Sjøberg (2004), the principal concern of education should be to empower children to act responsibly with environmental issue and to recognize their ability to take positive actions. O'Malley (2015) identified children as "powerful agents of change" and education "[is] as one of the best ways of strengthening community resilience and providing pathways to negate the worst effects of climate change" (O'Malley 2015, p.102). Accordingly, and in order to empower

students to take actions, EE should engage children in articulating, discussing and acting on environmental problem. In reality, one of the fundamental goals of EE is to equip students with the skills to make more thoughtful decisions about environmental issues.

Educators appear to play the major role in helping students understand the notion of the complex causality that exists in nature and in "fostering an awareness of how students' own actions can help or harm our world" (Shafer 2015). Teachers are invited to develop students' skills for making appropriate "environmentally friendly" decisions, to help them understand and appreciate the complexity of environmental change and most importantly, "to tackle hard environmental problems or stick with daily choices that pay off in the long run, to use the Internet and to spend time outside noticing the patterns, biodiversity, and beauty surrounding" (Shafer 2015).

It is documented that Environmental attitudes are perceived as preconditions toward the achievement of environmental behavior (Kollmus & Agyeman 2002) and that the acquisition of environmental behavior is considered as the ultimate goal of the environmental education process (Hungerford & Volk, 1990, Changing Learner Behavior through Environmental Education, p. 257). But as stipulated by many psychologists and sociologists, acquisition of environmental knowledge and attitudes does not necessarily lead to change in behavior (Eilam & Trop 2012). Complex relationships exist between attitude and behavior. Kollmus & Agyeman (2002) affirmed that: "the longer the education, the more extensive is the knowledge about environmental issues [.] [;] Yet more education does not necessarily mean increased pro-environmental behavior" (Kollmus & Agyeman 2002).

In reality, what is called "pro-environmental consciousness" is shaped by internal factors like environmental knowledge, values, and attitudes; together with emotional involvement, personal values, and personality traits and by external factors like social and cultural aspects (Kollmus & Agyeman 2002). Accordingly, the models of pro-environmental behavior based on a linear

progression of environmental knowledge leading to environmental awareness and concern, which in turn was thought to lead to pro-environmental behavior are nowadays refutable (Burgess, Harrison & Filius 1998).

Evoking Albert Einstein's quotes that ‘The significant problems we face cannot be solved by the same level of thinking that created them’ (Einstein 1946), we recognize that multidisciplinary learning is not sufficient to directly influence students’ behavior. In fact, students need to think "out of the box" and out of the one-dimensional and linear learning process. Academic learning, inter and multidisciplinary learning, multidimensional learning, and emotional learning are four essential principles of the EE and ESD pedagogy. In recent EE/ESD discourse, ethical and value clarification evolved as a highly desired outcome of the educational process (Breiting et al., 2005). Thus, fostering students’ ability to negotiate between their IQ and their EQ and involving rationality and feelings, ethics and values, teachers can combine Cognitive Learning with Emotional Learning and achieve effective team work and cooperation.

2.4.2 The use of Revised Bloom’s taxonomy

There are three main components in the learning and teaching system. The first component that will be addressed is standards including learning outcomes. The second component is teaching methodology or teaching approach. These two components are evaluated as successful by the third component which is the assessment. Popham (2004) explained that standards show what is expected to be taught and learned whereas and as asserted by Fuhrman (2001), teaching is the tool that help translating. Fuhrman (2001) discussed furthermore the fair opportunity that teaching should give student to attain the needed skills and content.

The role that assessment plays is indeed similar to a judge between standard and teaching. It shows how much teaching did a good job in making students attaining what was expected. This idea was explicitly expressed in the study of Biggs (2002). Moreover, investigation linked to long term knowledge in the field of environmental science must be evaluated upon the alignment between standards, teaching and assessment. The textbook of this study provides in fact different types of assessment. The comprehension part and the seeking solution part will be addressed in order to analyze the degree of alignment. Alignment is the most important factor that makes education successful. The same idea was supported by Smith & O'Day (1990) in their studies on functional standard based education.

As previously mentioned, this study is evaluating the degree of alignment offered in the textbook. In order to do so, the textbook standards and assessments will be objectively used as the two main components in the alignment analysis; the teaching methodology will not be taking into account. These two components and as asserted in the study of Roach, Niebling & Kurz (2008) are found to be enough in the alignment analysis. According to RBT and in order to analyze the standards and assessments, categories for comparison need to be formed (Bhola, Impara & Buckendahl, 2005). Moreover, there are two main criteria in alignment to be considered: the content and the cognitive complexity. The trend in alignment models is to analyze the alignment between standards and assessment and not teaching and standards. In this way, the analysis done is found to be more objective because it does not rely on the variation of teaching methods.

Indeed, assessment is a very important tool that can be used in various directions. It can be used to help students know where they stand and provide them with a valid feedback. In addition, the assessment results are used and considered by stakeholders whenever a reform or new decisions to

be taken are needed in the education field. This is why, and due to its high importance, a clear alignment between standards and assessments should be reliable and trustworthy.

The model of categorization used in this study is the RBT. There is a difference between what is expected from students to know and how well the students are expected to attain. Learning assessment is a very important process in the life of students and teachers. Assessment is a process and should be systematized. It collects evidence about how well the students are learning. It can be considered as a research since it contains all the elements of a research like recording, scoring, observing and analyzing the results of these assessments. They provide the students and teacher with feedback about the instruction and learning happening in the classroom. It is also an evidence for the level of achievement of the student.

What is the best way to start with assessment? We need to call assessments by system of assessment and this system begins with definition of the learning outcomes. These outcomes are targets for the learning process. They guide the way toward a clear target. We need to have alignment between assessments and objectives so that the learning process occurs smoothly. The word alignment means a link or connection between the three factors: outcomes, learning process and assessment. Alignment assures that we are going in the right direction and that targets are to be reached. In contrast, the misalignment causes a bad impact to the whole learning process, the course itself will be ineffective, the students will not be able to understand what they are learning, the time will be waste and the activities will not be able to help students to apply knowledge and critical thinking.

The literature review of this study highlighted the importance of the Environmental Science Education at different levels. The alert observed among stakeholders toward environmental awareness explains furthermore the importance of this study. Keeping this in mind, the textbook analysis presented in this study will focus on the importance of the Environmental Science Course in

developing advanced skills and encouraging students toward environmental sensitivity, awareness, critical thinking and behavior modification.

Chapter 3

3. Methodology

3.1 Research Approach

The attempt of this research study is to describe the direction used by stakeholders when they design and think about assessment. In order to do that, the study focused on assessment and learning objectives in the textbook used in an introductory environmental course in one high school in Abu Dhabi-UAE following the American curriculum. Assessment and learning objectives are the most powerful tools and factors that direct the learning process and evaluate how well it works (ETS 2002). However, this study is limited to one course in a specific school of UAE and further analysis can be done in the future to address other school experiences in the field of EE.

When we discuss research methods, we think of qualitative and quantitative approaches. Quantitative approach is built on a measuring system that quantify the links between two factors and statistics are used to validate or refute hypothesis. Although quantitative methods are reliable and most of the time valid, we cannot ignore the importance and the role of qualitative method in the cases of limitations of the quantitative approaches. There is a support to the usage of qualitative method as a useful and reliable one when small sample populations are considered.

Since this study is focusing on a small sample of learning objectives and assessment methods represented in the Environmental Science course textbook of one high school in one of the Emirates of UAE, the qualitative approach will be used. The focus will be made on content analysis study and specifically on two aspects provided by the textbook, the learning objectives and samples of assessment methods of chosen chapters in the book under study.

As it is well known, different types of qualitative analysis exist but this study will only use the content analysis of parts of the curriculum especially learning outcomes and assessment strategies. This analysis will examine the frequency and quality of terms and concepts through active verbs represented in the learning objectives and assessment statements of the textbook, by using RBT and

categories for learning objectives and assessments. As Sandelowski (2000, p. 335) mentioned, the descriptive content analysis shows facts in everyday language and should depend always on perception and sensation.

Before looking into the different cognitive categories that learning objectives and assessments fall into, a presentation of some aspects of textbook analysis will be made and that will help later on in forming conclusions and discussing the outcomes. In fact, a Textbook content analysis may be affected by a wide range of factors and can have different applications that depend on the type of material we are dealing with. According to previous research and scholars, the analysis of a textbook is not simply counting words. It is more linked to the social fact that represent the audience whether teachers and/or students; Zhang and Wildemuth (2009) indicate that "content analysis goes beyond merely counting words" (Zhang and Wildemuth 2009).

Content analysis is considered as well as an interpretation of the material through classification of themes. An overview on the chapters of the textbook under study shows that it covers the needs of the students in developing their knowledge in the environmental science field and its applications but a deeper analysis on the learning outcomes and their alignment with the assessment provided by the textbook is needed.

For this purpose, a qualitative method through categories provided by RBT will be used to investigate if students and teachers can use this textbook in order to build a long-term learning with application and creativity. In our research, the qualitative approach tends to offer more benefits than the quantitative approach since it allows us to see the themes and their implications in the learning process of the student.

At the beginning of a textbook evaluation, there is a need to consider the audience to which the textbook is written. Since a textbook can be a tool to provide new information that summarize

and digest of a body of knowledge (Rajasekar, Philominathan & Chinnathambi 2013), it can represent as well a body of knowledge in a new form or a new mode. Moreover, textbook can also fall under the category of subsidiary books or introductory books, as the textbook of this study. In addition, textbooks need to be systematic and to present the information in a new trend in an attempt to attract readers especially if these readers are students; in fact, textbooks are a tool that goes beyond being only a resource since they inspire and talk to students.

The textbook of this study is used for instruction under the American curriculum and is given to students in grades 11 and 12 and fall into the introductory books category. This type of books presents the main theories and essential concepts. Students should be able to build through this book a firm base of essential knowledge in the field of EE. Usually, introductory books may present different point of views and applied examples when addressing subjects.

In general, textbook reviewers evaluate a textbook from its content and the choice and selection of its topics and concepts (Webster and Watson 2002). Coherence and systematicity are two important factors in looking at the content of a certain body of knowledge. (diSessaa et al., 2004)

Teaching from a book is not always an easy task especially when a lot of concepts are needed to be covered, the book may fall in being so difficult to be learning tool. There is a feeling that if the book is educational it will not be easy (Galanter 1966). Textbook should not be dulled and just full of information but it should show some innovation. Since the study textbook is an introductory one, a summary of the purpose of an introductory book might be useful. Introductory books are used mainly in introductory courses like the Environmental Science course offered in high school. It helps in familiarizing the students with direct principles and relate them to the study field. In addition, it sheds the lights on the application of these principles in the daily human activity. It may introduce as well a history of the subject explored.

The title of the textbook of this study “Science behind the stories” reveals a lot and give an idea about the authors’ intentions and what they might offer to their audience. The preface comes to prove what the title of the textbook reveals. Behind the stories of sciences lie new ideas and concepts to those exploring the book. It presents a comprehensive framework and context where authors have built their main focus.Many questions can be raised around the textbook title and content, but the main focus will remain around the textbook contribution in the field of study, the degree of success and the value of the information organized in it.

The most important value concerning this study is how much the textbook is a successful learning instrument through the objectives and assessments it provides. In analyzing the textbook, we look at its content and in its organization. Without forgetting to mention that some textbooks may lead readers and especially students to misconceptions due to bias it that it may contains. Consequently, and as mentioned in the literature review, we need to identify how students learn and assimilate the concepts related to the environment such as the concept of climate change and others.

3.2 Data Collection

Learning outcomes are precise statements of what faculty expects students to know and to be able to do in some measurable way as a result of completing a program, course, unit, or lesson (Huba and Freed 2000; Anderson 2006). In addition to guiding teaching, learning, and assessment strategy, effective learning outcomes facilitate student orientation to the subject and communicate expectations (Chadwick 2004). For effective learning to take place, there is the need for constructive alignment of the curriculum, which ensures that an education program, the learning outcomes, teaching and learning approaches, and assessment techniques are precise statements of what faculty expects students to know and to be able to do in some measurable way as a result of completing a program, course, unit, or lesson (Huba and Freed 2000; Anderson 2006).

This study will not cover all the aspects of the textbook used for analysis. It will mainly focus on two components: samples of learning outcomes and samples of assessments strategies provided by the textbook to investigate the degree of alignment between these two components. Alignment is a broad issue and can be defined from different perspectives. This chapter will overview the alignment concept and sheds the light on what is relevant to the study subject of this paper. As said previously, the qualitative approach will be used in the content analysis in order to judge the degree of alignment between components of the environmental science book and the curriculum used. A description of the method in addition to rationale is included as well.

Learning objectives are generally statements that direct what the student might learn. If these statements are clear, the assessment design will be easier and more effective. Deakin University summarizes the role of learning objectives as statements that need to describe the skills and knowledge that the student will be able to demonstrate (Anderson & Krathwohl 2001). These statements should contain a noun or noun phrase in addition to a verb that describes the cognitive level required. Learning objectives are so direct and precise and show what teachers and curriculum specialists want from the students to achieve in a measurable way. Effective learning objectives make things easy on the students when they need to know what is expected from them but it does not minimize the role of teaching guidance and assessment strategies (Chadwick 2004).

In order to make sure that effective learning is happening, there is a clear need for curriculum alignment. This alignment will show that objectives, teaching practices and assessments strategies are all complementary to each other. (Chadwick 2004. In order to succeed in the learning task, students need to apply their knowledge and not only remember it. Remembering is the lowest order of the skills in the cognitive domain. If we compare memorization, recalling versus critical thinking,

we find that the latter needs in depth understanding classified as a higher order cognitive skill. Zoller (1993) Crowe et al. (2008) confirmed this idea and stated that higher level of cognitive skills need deeper understanding. This will affect the design of the curriculum since the higher the level the more creativity is needed in designing the curriculum (Napoleon 2006). This creativity will result in more collaboration and engagement from the student's side. The creativity level of the Environmental Science course will be investigated in this study.

To judge the level of alignment between assessment strategies and learning outcomes RBT will be used as a tool to assess this alignment and to emphasize on the higher cognitive domain. Crowe et al., (2008) accepted RBT as an alignment tool and divided the taxonomy categories into different levels such as Evaluation, Synthesis, Analysis, Application, Comprehension and Knowledge. Anderson et al., (2001) mentioned that the RBT provides a clearer and better classification of the cognitive skills using verbs instead of words. The verbs replaced the following words: Remembering instead of knowledge, understanding instead of comprehension, applying instead of application, analyzing instead of analysis, evaluating instead of synthesis, Creating instead of Evaluation. The last two levels were shuffled so creating becomes the most complex and highest in the cognitive level.

Two dimensions are observed in RBT: the horizontal one that shows the different levels of cognitive process and the vertical one that shows the different types of knowledge; the conceptual, factual, procedural and the metacognitive. In fact, RBT is found to be an important tool since it contains a framework that can enhance curriculum alignment and show the actual learning of students. In addition, the way the table of RBT is organized makes it a generic table that can be used by all subject matters.

One of the objectives of this paper is to observe the cognitive domains of RBT in order to check the cognitive level of learning outcomes in environmental science course and their

corresponding assessment in addition to their alignment together. First, the learning objectives or outcomes will be assigned to their appropriate cognitive level guided by RBT. If we dissect the learning outcome statement we can find a verb or the verb phrase in addition to a noun or noun phrase. Krathwohl (2002) shows it in a way and put it in the following order: Student behavior- Verb- Subject and explain how any learning outcome can find its place in the RBT table. RBT maps the assessment and shows its links to the objective.

Furthermore, RBT will help in deciding if the student could get enough understanding in order to master the subject or the material under study. Benjamin Bloom thought of six different cognitive stages that are observed in the learning process. These levels are classified in order of complexity and starts with Knowledge then Comprehension followed by Application and Analysis then ends with Synthesis and Evaluation. Bloom described knowledge as a simple recall of facts and concepts. Comprehension was considered the lowest level of understanding.

Application is the ability to use information in order to solve a real-life problem that the student is not used to. The last three levels will require more critical thinking. For example, analysis will require the student to break down concept learned and find deep links and relationship. Synthesis will require kind of the opposite since it puts pieces together in a new way to the learner. The last level in critical thinking will be evaluation which requires student to make judgements and use appraisal within a certain concept ok knowledge.

Phye (1997) mentioned that different levels in RBT can used interchangeably like comprehension and application because the latter is an indication of the earlier. A student indicates comprehension through the ability of application. The most important thing is to show a level of critical thinking and not only recalling information. The best assessment or the one described as quality assessment should measure how well the learning outcomes are met. There is an agreement

that most of the assessment written by teachers or even provided by books fits the knowledge or remembering level of Bloom's taxonomy.

Biggs (2000) relates the good learning environment to alignment between assessment, teaching practices and learning outcomes that will support learning at a higher cognitive level. Project-based learning is a clear example of such high cognitive level or learning. When teaching focuses on training students to solve real life problems it encourages them to reach higher cognitive levels. The assessment of such teaching and learning method will be to investigate how well the students solved these problems. As we have mentioned earlier concerning the importance of environmental sciences and the approach we need to teach it. Investigation will spot the light on how much the textbook used this approach and stressed on the real-life situations in objectives and assessments in environmental course which reflects the high cognitive level that students may reach.

Mayer (2002) insists on two important features in goals of education. First one is to endorse retention and the second one is the transfer of knowledge. When these two factors exist, significant learning will occur. Retention is needed but it should be complemented by transfer of knowledge. Transfer is the usage of knowledge or what have been learned in solving problems and answering challenging questions. This is supported by Mayer (2002) when she expresses retention as something that happened in the past and transfer as an emphasis of what will happen in the future. Having this in mind we can apply it on how learning objectives are designed or created. It is clear that learning objectives that target retention are easy to create but it will be more challenging to construct objectives aiming and promoting transfer of knowledge (Baxter et.al, 1996). These objectives focus on cognitive processes that goes from understanding to creation. We will be looking at how well the learning objectives in the environmental science Book fit within the transfer of knowledge box.

Assessment should reflect also the same cognitive level. Alignment at this level will reinforce learning . A very important and genuine indicator of teaching and learning activities in the objectives

are verbs and verb phrases. Same or similar verbs should be used in assessments in order to keep teachers and students on track according to Biggs (2000).

There is a clear need for coordination between curriculum, instructions and assessment. Webb (2002) defines Alignment as "the degree to which expectations and assessments are in agreement and serve in conjunction with one another to guide the system toward students learning what they are expected to know and do." (Webb 2002)

The objects of inspection in our environmental course are the learning outcomes and the assessments we are considering at the end of sample chapters. All parts should work together when there is alignment. This will facilitate the learning and guide the instruction (Webb 2002). The validity of assessment can be measured by an alignment analysis. It will also identify the weaknesses in an education system and give room for improvement.

Furthermore, an overview on the different factors that affect the degree of alignment will be done. This will help in the decision if the two components analyzed are aligned or misaligned. The first factor to be discussed is the categorical concurrence. It focusses on the content of learning objectives and assessment design. It checks the similarity in content categories. It is a general but important indication. Both documents should show approximately same content so we can say there is categorical concurrence. Another factor in alignment is the depth of knowledge. The complexity of knowledge is required by the learning outcome and the assessment. The consistency in depth of knowledge will indicate a high degree of alignment since it tests the students on what it is expected in the learning outcomes. A study accepted a certain level of consistency if 50 % of corresponding items were present between standards and outcomes. Alignment analysis need the criterion of depth of knowledge in order to determine the degree of alignment.

Different levels exist when we consider the depth of knowledge factor. The recalling level is the first level and includes information linked to facts, terminology, procedure or performance. This

level can be identified by terms like use, measure, recall, identify and recognize. Other verbs appear in this level like explain but it can be classified at other level since it depends on the content of the explanation. The skills or concept level comes second. It represents a process shown in the learner's response. There are decisions to be taken by the student at this level. It tests how the student approaches a problem.

In our study, we are keen to search for these types of assessment to see how much we are training the student to solve problems related to the environment in the future. Verbs like organize, classify, estimate, display and compare are grouped in this level. These action verbs require many steps in the students' answering process. As mentioned earlier, few verbs will be found located at different levels depending on the learning outcome statement. If we consider a simple example like interpreting a graph. This may be at the second level if only it requires reading and writing down the information since this is considered as skill. But when decisions are to be taken considering the information in the graph, this will be considered as level 3 in depth of knowledge.

Level 2 shows the skills mainly but it should not be only interpreted as skill. Skills can be complex and can extend to other levels. For example, visualization and probability skills are more complex than others. Other activities under level 2 will be experimental procedures, collecting and organizing data, using displaying data in charts, graphs or tables. Above these two levels of recall and skills, we reach the third one which is the strategic thinking level. At this stage, the student is required to reason well, to use evidence and to plan according to a higher level of thinking in addition to estimation exercises. The third level is known to be complex and abstract and requires demanding reasoning. So more than one possible answer for a certain question with justification is at level 3. At this level, we can observe the following tasks like drawing conclusions, listing evidences, phenomena explanation and building logical arguments. The most important activity that we are interested to see in our study is to find learning outcomes and assessments that show the concept of solving problems.

The fourth level in depth of knowledge will be the one that requires complex thinking, reasoning, planning and which is done over a period of time. The time is needed to do complex work and make several connections. The verbs that we encounter in level 4 are many like design an experiment, conduct an experiment, make connections, combining ideas, designing an experiment and synthesizing new ideas.

As mentioned previously, there are three main components in the learning and teaching system: standard, goals or learning outcomes affect teaching and are evaluated in assessment.

3.3 Data Analysis

The focus of the research study is on the alignment between learning outcomes and assessments provided by the textbook using RBT. This approach is necessary to discover if the textbook used in one of UAE high schools encourages teachers and curriculum designers to plan for an aligned curriculum thus promoting high cognitive skills. In order to do this, the learning objectives of chosen chapters from the textbook will be grouped according to the cognitive level described in RBT by isolating the verbs and evaluating the phrases that comes with it.

The second phase will be to check on the assessments provided by the textbook and check also the location of each in the cognitive dimension according to RBT. We will then describe how well the assessments hit the learning objectives and at what cognitive level. This will be done qualitatively through organized tables attached in the appendix. This simple exercise may indicate in a general way how much the textbook is a successful tool in preparing students to become critical thinkers and problem solvers packed with long term knowledge in the field of environmental science. We have chosen three chapters that represent the main topics we have explored in the literature review and that tackles the spread of awareness among the students in addition to the practical part like sustainability and policy application and execution.

The book is organized in two main parts, the first one approaches the foundations of environmental science and the second one discusses the Environmental issues and the search for solutions. The first part includes 7 chapters and the second one 17 chapters. The first part overviews sustainability, Earth physical system, Evolution, biodiversity, population ecology, Interactions among species and communities in addition to ecosystems. The two remaining chapters discusses ethics, economics, sustainable development and environmental policies that help to make decisions and solving problems.

The second part discusses most environmental issues and encourage the search for solutions. It discusses the following topics:

- Human population
- Soil and Agriculture
- Agriculture, Biotechnology, and the future of food
- Biodiversity and conservation biology
- Forests, forest management and protected areas
- The Urban environment: Creating sustainable cities
- Environmental health and toxicology
- Freshwater systems and resources
- Marine and coastal systems and resources
- Atmospheric science, air quality, and pollution control
- Global climate change
- Fossil fuels, their impacts and Energy conservation
- Conventional energy alternatives
- New renewable energy alternatives
- Managing our waste

- Minerals and mining
- Sustainable solutions

The textbook offers as well a collection of appendices that can help student interpret the knowledge and skills provided by the textbook.

Since the textbook provides a wide focus on different areas of environmental science, this study has chosen mainly general knowledge chapters and those related to policies and practical approaches in order to check at what cognitive level they train the students through their learning objectives and assessments in addition to alignment between them. This will help in deciding how successful is this tool in preparing an aware generation concerning environmental threats.

3.4 Delimitation

In the preface of the textbook, the author sends a message to the student and to teachers. The message for the students includes a clear statement about the importance of sustainability in the future. The authors describe how our generation is enjoying a lot of technologies and advancement but at the price of depleting the resources of our earth. They insist that this course and especially this textbook will shape the future of the students by the different concepts and phenomena that they will learn in its context.

This study is investing one tool out of many used in successful education. Text book is an important tool for the student as well for the teacher, and can make a huge difference in the approach of how teaching and learning occur. The study gives a general idea about how well the assessments are aligned with the learning objectives but could not cover the statistical research since it is meant to have a general aspect in measuring how well the learning objectives and assessments fit the high cognitive level in learning process.

3.5 Ethical consideration

The main purpose of any scientific research or study is to share results and ideas and get feedback for any possible enhancement in the field. Since education is an important field in building communities and help humans to develop, encouraging any research or study in this field is needed to become the cornerstone for more and more development. This zeal to do more and more research may lead us into a kind of distortion. We may lose the validity of any potential research. The main obstacle that we may encounter is Bias. This may lead us to deviation in outcome because there is prejudice. This may have many roots like competition in the field, keeping funds or just personal interest. We can give examples of Bias from different fields like research in Science, engineering, and other key sciences where we can observe data as key basis of competition. Many studies mentioned that more than 80 % of research publications do not add a lot to the advancement of the respective field. We can class bias in different categories after a good number of Bias was analysed in different areas of science and other fields. Bias can be caused by three different factors, ignorance, design and misrepresentation.

The one caused by ignorance can be simply a fault usage of a certain tool. The design can support a certain result over others or diminish the effect of one factor over the other. A lot of factors cannot be controlled in most designed experiments. The misrepresentation is the third category. It is like always viewing things in a positive way or they say looking at the full part of the glass. Bias can be avoided simply by depending on Ethics and Integrity. In the case of our study, none of the causes of Bias are present since it is done for the sake of checking the level of awareness a certain textbook can provide to students in a specific course and there is no interest in showing positive or negative results. The textbook was chosen simply because it is the only tool of instruction used in this course. A

question arise from this situation and may be discussed in further studies. We may question the way a textbook is selected for a certain course and what criteria are taken in consideration.

3.6 Trustworthiness

The method used is the document analysis and focusing on outcomes and assessments provided by the textbook. We checked matching for cognitive processes and content. The revised Bloom's Taxonomy or Anderson and Krathwohl's taxonomy was used in order to identify the higher order cognitive level thinking. The cognitive processes did not fit all the higher levels and alignment. This analysis provided kind of data that can be used to evaluate textbook, curriculum, syllabus, lesson plan or assessment design.

The alignment diagnosis should show if there is absence or presence of matching with high cognitive level thinking. There is difficulty in determining the complexity of thinking especially the last three levels of Bloom's taxonomy. Teachers, instructors, books authors can think about a certain level when writing assessments but it doesn't mean that the students will think the same way when they answer these assessments. All depends on the students' expertise in the field. If we consider students who are exposed for the first time they will feel that they have put more effort and thought deeply about a certain question. Those who are exposed previously to such tasks will find easier. So, prior knowledge and experiences among students may be a variable factor. This may lead us to validate the method used in this since it ignores the students and focuses only on verbs used in learning outcomes and assessments. This doesn't mean to ignore the population of students. At the end, they are at the center of the learning process and what is relevant for them is the most important.

Chapter 4

4. Results

4.1 Analysis of Qualitative data

This book is offered for non-major students in environmental sciences. It is an introductory course. The title:" The science behind the stories" tells a lot and indicates that it will relate science to everyday life situations. This book helps the students' engagement by presenting case studies and support it with most recent understandings of the environmental science field and is meant to help students in interpreting and analyzing data. It is also supported by an online tool that provides homework suggestions, assessments and tutorials. It includes as well activities that prepare students better for the class.

The following new case studies are included in the book and stated below as examples.

- Saving Hawaii's Native Forest Birds in Chapter 3
- Farm to Table —and Back Again–The Commons at Kennesaw State University in chapter 7.
- Will We Slice Through the Serengeti? In Chapter 8
- Clearing the Air in Los Angeles and Mexico City in Chapter 13,
- Hydrofracking the Marcellus Shale in Chapter 15.

Different updates were included in the textbook concerning important and recent topics worldwide. We can mention the coverage about climate change, sustainable development in economy and policy, in addition to energy use especially in renewable energy fields.

The book includes activities that help students get engaged in designing experiments and analyzing data. Graphs and data questions are also available which help students develop skills used

in environmental sciences. Quiz questions that help students to prepare for the lesson and helps teachers to evaluate the level of the students are presented the beginning of each lesson or unit.

The online tool provides as well recorded field trips as videos about waste water treatment facilities, sustainable agriculture, wind power, Invasive species, water desalination plants, bee colony collapse in addition to coal fired plant and some more. The ecological footprint calculations that are friendly with math phobic students are other important features in the book.

The content of the book is highly valuable for EE since it fits the expectations of Belgrade Chart which lists the principles of this field. For example, we can mention the part that discussed these principles of EE programs as discussed in summary table 2 below.

Table 2: Guiding Principles of Environmental Education (UNESCO 1975, p.4)

- Environmental education should consider the environment in its totality – natural and man-made, ecological, political, economic, technological, social, legislative, cultural and esthetic.
- Environmental education should be a continuous life-long process, both in-school and out-of-school.
- Environmental education should be interdisciplinary in its approach.
- Environmental education should emphasize active participation in preventing and solving environmental problems.
- Environmental education should examine major environmental issues from a world point of view, while paying due regard to regional differences.
- Environmental education should focus on current and future environmental situations.

- Environmental education should examine all development and growth from an environmental perspective.
- Environmental education should promote the value and necessity of local, national and international cooperation in the solution of environmental problems.

The content of book as represented in the list of chapters and authors' approach expressed in the preface, fits 6 out of 8 items of these principles since items 2 and 3 fit more a full program for K-12.

The authors of this book have a scientific background. Withgott is a researcher in the fields of Ecology, Evolution, animal behavior and conservation Biology. He has experience as instructor in university lab courses. The other author, Laposata, is a professor of environmental science holding a bachelor's degree in biology education and a master degree in biology from Bowling Green State University, and a doctorate in ecology from The Pennsylvania State University. Matt is a coordinator of two-semester course in the field of environmental sciences, He focuses exclusively on introductory environmental science courses, and has enjoyed teaching and interacting with thousands of non-science majors during his career. He is active in environmental science education in addition to developing and evaluating innovative curricular materials.

4.1.1 Analysis of Chapter 1 in Textbook: "Environment, The Science behind the stories"

In the study and observation done, we have selected three chapters that represent our interest in sustainability and basics of environmental science course. The Tables used in order to evaluate the cognitive level and knowledge dimension are attached to this document. We will look at each table

once at a time. There are nine tables that represent the findings about learning objectives and assessments of chosen chapters.

The first chosen chapter is chapter one in the book and is about Science and sustainability. It was chosen simply because it fits the objective of this paper which investigates about how well future generation will be prepared to be sustainable and use this field in order to solve problems of the environment in addition to its general aspect as introduction to the Environmental science field. The second selected chapter is chapter 5 in the book and is about basic knowledge and applications about the environment and ecology. It represents the basic knowledge about ecology and ecosystem and the study will describe how well it helps the students in thinking at higher cognitive level. It has a fundamental aspect about ecology but relates it to daily life circumstances. The third chapter selected is chapter 6 in the book and it is about Ethics, Economics and sustainable development. This chapter was selected knowing the importance of these at the global level as described previously in the literature review.

The authors of the textbook included seven goals of learning objectives in chapter 1. By looking at the verbs and phrases used, we can observe qualitatively by using the revised bloom's taxonomy that these objectives were distributed among four categories out of six cognitive process dimensions and none was find in the Apply or create category. The was fair distribution among the first three knowledge dimension. Table 1 shows the list of learning objectives and table 2 shows their distribution according to the guide provided in Appendix 2.

Table 1: Learning objectives Ch1.

Chapter 1: Science and Sustainability: An introduction to environmental science **Chapter 1 Learning objectives** LO1 **Define the term environment and describe the field of environmental science** LO2 **Explain the importance of natural resources and ecosystem services to our lives** LO3 **Discuss the consequences of population growth and resource consumption** LO4 **Characterize the nature of environmental science** LO5 **Understand the Scientific method and the process of science.** LO6 **Diagnose and illustrate some of the pressures on the global environment** LO7 **Articulate the concept of sustainability and describe campus sustainability efforts**

Table 2

Chapter 1: Learning Objectives classification according to Revised bloom's taxonomy verbs

Knowledge dimension Vs. Cognitive Process dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	LO1	LO1			LO3	
Conceptual Knowledge		LO1 LO4 LO7		LO2 LO6	LO2 LO3	
Procedural knowledge	LO5	LO5				
Meta-cognitive knowledge						

Chapter 1 also provides students with two different types or forms of assessment. The first set of questions is titled, test your comprehension and the second set is titled “Seeking solutions”. Both forms reflect in their titles the content and cognitive levels they hit observed in following tables 3 and 4. Table 3 shows that majority of questions fits the first two cognitive levels according to Bloom’s and they cover mainly the first three knowledge dimensions. Table 4 investigates the “seeking solutions” part and it shows that majority of questions hits the Analyze, Evaluate and Create levels.

Table 3

Chapter 1: Assessment classification/ Test your comprehension part (questions: Q1-Q9)

Knowledge dimension Vs. Cognitive Process dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	Q1 Q3 Q4 Q5 Q10	Q1 Q2 Q4				
Conceptual Knowledge	Q3 Q5	Q2 Q4 Q6	Q2	Q2		
Procedural knowledge	Q6 Q7 Q8	Q6 Q8			Q8	
Meta-cognitive knowledge	Q9			Q9	Q9	Q9

Table 4

Chapter 1: Assessment classification/ Seeking solution part (Questions: Q1-Q6)

Cognitive Process dimension Knowledge dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge				Q1		
Conceptual Knowledge		Q2	Q1	Q1 Q2 Q4 Q5	Q1 Q2 Q4 Q5	Q2
Procedural knowledge						
Meta-cognitive knowledge				Q3 Q5 Q6	Q3 Q5 Q6	Q3 Q5 Q6

4.1.2 Analysis of Chapter 5 in Textbook: "Environment, The Science behind the stories"

Chapter 5 is titled "Environmental systems and Ecosystems ecology" and includes six learning objectives represented in table 5 below. These objectives deal mainly with environmental subject area fundamentals. In this case it is expected to have most of the objectives focusing on the first two levels of cognition according to Bloom's taxonomy in addition to few hitting the analysis and evaluation cognitive levels. Table 6 represents the results of classification and shows that no outcomes were classified in Apply and Create categories. The Assessment in Ch.5 is also represented in two parts. The classification of verbs and phrases in the comprehension part is represented in Table 7, It shows majority of assessments hitting the first two levels of the cognitive dimension and covering the factual, conceptual and procedural knowledge dimension. Mainly most of assessment didn't hit the Apply or Create groups. This indicates kind of an acceptable alignment between the learning objectives and this group of assessments. Table 7 represents the analysis of seeking solution part, it shows a fair distribution between the second level and last level of the cognitive dimension with a focus on the understand and Evaluate categories. These two levels encourage students to develop critical thinking and long-term learning. Although it is a content of basic knowledge, the authors included outcomes and assessments that tackle higher levels of cognitive process. The components of this chapter show alignment and help the students to think at higher cognitive level.

Table 5: Learning objectives Ch5.

Chapter 5: Environmental systems and Ecosystem Ecology
Learning objectives
LO1 **Describe the nature of environmental systems**
LO2 **Define ecosystems and evaluate how living and nonliving entities interact in ecosystem level ecology**
LO3 **Outline the fundamentals of landscape ecology, GIS and ecological modeling.**
LO4 **Assess ecosystem services and how they benefit our lives**
LO5 **Compare and contrast how water, carbon, nitrogen and phosphorus cycle through the environment.**
LO6 **Explain how human impact is affecting biogeochemical cycles.**

Table 6

Chapter 5: Learning Objectives classification according to Revised bloom's taxonomy verbs

Cognitive Process dimension Knowledge dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	LO1 LO2	LO5		LO6		
Conceptual Knowledge	LO1 LO2 LO3	LO1 LO2 LO3 LO5		LO6	LO2 LO4	
Procedural knowledge				LO4 LO6	LO4	
Meta-cognitive knowledge						

Table 7

Chapter 5: Assessment classification/ Test your comprehension part (questions: Q1-Q10)

Cognitive Process dimension Knowledge dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	Q1 Q5	Q3 Q4 Q7 Q8 Q9 Q10			Q6	
Conceptual Knowledge	Q2 Q5	Q2 Q3 Q4 Q5 Q7 Q8 Q9		Q6 Q8	Q2 Q6	

Procedural knowledge	**Q2**	**Q10**		**Q10**	**Q10**	
Meta-cognitive knowledge						

Table 8

Chapter 5: Assessment classification/ Seeking solution part (Questions: Q1-Q6)

Knowledge dimension Vs. Cognitive Process dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual Knowledge		**Q2**		**Q1**	**Q1**	
Conceptual Knowledge		**Q2** **Q3** **Q4**		**Q1** **Q3**	**Q1** **Q2** **Q3**	**Q5**
Procedural knowledge			**Q6**		**Q5** **Q6**	**Q6**

Meta-cognitive knowledge						

4.1.3 Analysis of Chapter 6 in Textbook: "Environment, The Science behind the stories"

Chapter 6 is a very important key indicator for our study since it discusses Ethics, Economics and sustainable development. These titles were discussed thoroughly in the literature review and represent an important indicator of how well this generation will be prepared to deal with these issues in the future. This chapter includes eight learning outcomes as shown in table 7. Table 8 shows their analysis which indicates that these learning outcomes are distributed among different levels of cognitive dimension except the categories Apply and Create, since no verbs or phrases were found referring to these. Majority of these outcomes are found in understanding, then the rest distributed in Analyzing and evaluating levels.

Table 9 represents "Test your comprehension" part of the assessments provided. It shows that these assessments hit equally the first two levels of the cognitive process in addition to analysis and evaluation categories. Application and creation categories remain empty for this group as well. Table 10 represents the results for "seeking solutions" part for chapter 6. We can observe kind of distribution of levels starting from Understanding till creation, with a main focus on analysis and creation.

We can observe that two cognitive levels were represented in the assessment part but didn't align with the learning outcome part.

Table 9: Learning objectives Ch6.

Chapter 6: Ethics, Economics, and Sustainable Development
Learning objectives
LO1 **Characterize the influence of culture and worldview on the choices people make**
LO2 **Outline the nature and historical expansion of ethics in western culture.**
LO3 **Compare major approaches in environmental ethics**
LO4 **Explain how our economies exist within the environment and rely on ecosystem services**
LO5 **Describe principles of classical and neoclassical economics and summarize their implications for the environment**
LO6 **Illustrate aspects of environmental economics and ecological economics**
LO7 **Describe how individuals and businesses can help move our economic system in a sustainable direction.**
LO8 **Explain the pursuit of sustainable development**

Table 10

Chapter 6: Learning Objectives classification according to Revised bloom's taxonomy verbs

Knowledge dimension Vs. Cognitive Process dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	LO2	LO1 LO2 LO3 LO4 LO5 LO7		LO4	LO4	
Conceptual Knowledge		LO1 LO2 LO3 LO5 LO6 LO7		LO1 LO4 LO7	LO1 LO4 LO7	
Procedural knowledge		LO8		LO4 LO8		

Meta-cognitive knowledge						

Table 11

Chapter 6: Assessment /Test your comprehension (Total Questions= Q1-Q10)

Knowledge dimension Vs. Cognitive Process dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual Knowledge	**Q1** **Q10**	**Q3**				
Conceptual Knowledge	**Q1** **Q4** **Q5** **Q9**	**Q1** **Q2** **Q3** **Q4** **Q6** **Q8** **Q9**		**Q2** **Q3** **Q6** **Q9** **Q10**	**Q5** **Q6** **Q7** **Q9** **Q10**	

Procedural knowledge						
Meta-cognitive knowledge						

Table 12

Ch 6 Assessment: Seeking solutions (Total Questions= Q1-Q6)

Knowledge dimension Vs. Cognitive Process dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual Knowledge			**Q1** **Q2**		**Q6**	**Q1** **Q6**
Conceptual Knowledge		**Q5**	**Q2**	**Q2** **Q3** **Q4** **Q5** **Q6**	**Q2** **Q3** **Q4** **Q5**	**Q1** **Q5**
Procedural knowledge		**Q6**				**Q1** **Q5**

Meta-cognitive knowledge						

4.2 Further Analysis

These three chapters with their outlines, content and assessments should give an indicator about the aim of the book and whether it is an acceptable or good tool that can help students develop their cognitive skills in the field of environmental sciences and prepare a generation that is aware of the threats that affect the environment. This should train them to become critical thinkers and problem solvers of the future. If we look at the outlines, assessments and even check the content of the book, we can find that it fits the ambition of a lot of stakeholders who have put plans for environmental education worldwide. Principles mentioned in Belgrade charter can be an example. These mention that education, public awareness and training must be considered in educational syllabus. These objectives were addressed by UN Environment Program and came as follow:

1. General awareness building: The relevance and importance of conservation and sustainability
2. Formal education system: Curriculum and material development and teacher training
3. Capacity building for development professionals and government officials: Sustainable development policy and planning skills

4. Promoting & Facilitating EE development in the formal school system: education specialists support development of regional/local curriculum, teaching materials and teachers training

5. Policy courses for development professionals

The textbook under study is used for students in grades 11 and 12 or for introductory course in university. The main concepts discussed in it fit the description given by Dr. Volk who defines five elements of EE with their major and minor emphasis in respect to grade level ranges in environmental curriculum design in table A below. As figured in ACEE guiding principles, these elements are:

1. Environmental sensitivity refers to an empathetic view of the environment.

2. Ecological foundations refer to having sufficient knowledge to make ecologically sound decisions.

3. Issues and values refers to developing an understanding of environmental issues and the values and implications surrounding them

4. Investigation and evaluation refers to the knowledge and skills necessary to evaluate issues and solutions

5. Action skills are those skills required to take positive environmental action.

Table A: Elements of environmental education in respect to grade level ranges in environmental curriculum design

Grade Level Ranges	Major Emphasis	Minor Emphasis
K-3	• Environmental sensitivity • Ecological foundations	• Issues and values • Investigation and evaluation • Action skills
3-6	• Ecological foundations • Issues and values	• Environmental sensitivity
6-9	• Ecological foundations • Issues and values • Investigation and evaluation • Action skills	• Environmental sensitivity
9-12	• Issues and values • Investigation and evaluation • Action skills	• Environmental sensitivity • Ecological foundations

And we continue in describing the approaches according to different education stages. If we focus on the secondary stage or pre-university stage, we can find that the textbook used in our study fits as well this vision. In the article figured on Biology Discussion website, Shah identifies specific objectives in EE with respect to school stages. Quoting from his article:

1. "Primary School Stage: In Primary School Stages, sensitizing the child about the environment is a necessity. Emphasis should be mostly (75%) on building up awareness, followed by real life situation (20%) and conservation (5%). Teaching strategy includes audio-visual and field visits'.

2. Lower Secondary Stage: At this level objective must be real life experience, awareness and problem identification. The contents are supplemented with general science. Teaching, practical and field visits are to be done'.

3.Higher Secondary School Stage: The emphasis must be on conservation, assimilation of knowledge, problem identification and action skills. Contents may be science-based and action oriented work.

4. College Stage: Maximum emphasis should be on knowledge regarding sustainable development and conservation. The content must be college based on Science and Technology. Teaching practical's and action-oriented field work is to be done. […]'

5. University Education: EE at this level is being looked after the UGC. The university education has three major components— Teaching, Research and Extension. At post graduate level, four major areas are recognized environmental engineering, conservation and management, environmental health, social ecology".

Kinghorn asserted that the methods and approaches selected by the teachers must be active and participatory to ensure maximum involvement and enough environmental learning opportunities for students. Learner-centered activities such as 'learning-by-doing, field-study, experimentation, group discussions, games, role-playing, project-work, problem solving and inquiry approach' are active learning techniques that must be encouraged in classrooms.

Chapter 5

5. Conclusion

5.1. Summary of the study

This research paper shows an overview about Environmental education from different perspectives. It indicates the historical importance and the value of stakeholders in education and other fields that give to Environmental education. This study used one sample course of environmental education that is offered in one school in Abu Dhabi and investigated two elements provided by the textbook used for instruction which are the learning outcomes and assessments. The study used qualitative data and investigated the cognitive levels of both learning outcomes and assessments provided by the textbook. The main purpose of the study is to analyze these learning outcomes and assessments in order to check how well they hit the different levels of the cognitive process according to Revised Bloom's taxonomy. It investigated as well the knowledge dimension presented in each of these elements. One of the main discussions was the alignment importance between different elements of curriculum. A quick overview of teacher's role as a link between what is intended in the curriculum and what the students achieve at the end of the learning process was discussed as well.

5.2 Key findings

The literature review can guide us toward one conclusion which indicates that spreading awareness among future generation about environmental issues is of tremendous importance. This study is a limited attempt that investigated one aspect of the multifaceted process of education in the field of Environmental science. After checking the different cognitive levels in learning outcomes and assessments in order to test the level of alignment between them, the results found can be presented as below:

- The book titled “The Science behind the stories” shows that it provides students with a tool that help them develop their cognitive skills at higher levels.
- In terms of knowledge dimension, it has proven that it hits mostly the first three dimensions of knowledge and hits mostly the understanding cognitive level according to Revised Bloom’s taxonomy in the assessment part titled “Comprehension”.
- It shows that it hits as well the higher levels of cognitive process in the assessment part titled “Seeking solutions”.
- The book in its content fits the stage level of high school students as well as introductory course at university level as discussed in the results part.

As mentioned previously in the study, there are three factors that affect the best learning process: Curriculum, teaching and assessment. Since we just checked the learning outcome as part of the curriculum and assessment. It is good to discuss the role of teachers although it was not part of the investigation. The book can be a great tool for students and teachers but it doesn’t replace good teaching strategies. It is simply a tool that can be used in the right direction or misused

5.3 Recommendations

The textbook investigated is a tool between teachers’ hands so they can support the learning of students in the best way. Since the text book seems to be investigated as a good tool and fits the requirements of a good learning process, we still need to recommend and discuss the role of teachers in this process. According to Yildiz, and because of time limitation, ‘teachers mostly use lecturing and question-and-answer sessions when teaching environmentally related topics’ (Yildiz) Involving students in creative activities such as recycling and re-using products, PowerPoint and poster

presentations, group projects and attending science festivals, seminars, and exhibitions are curricular and extra-curricular activities that must be envisaged when designing the environmental education curriculum.

One of the main tasks of teachers is to help learners to reach higher order of cognitive skills. Here we need to look at the alignment between the three factors, objectives, teaching and assessment. The latter should reflect the level of objectives. Crowe et al (2008) explained why students score low in examinations. This happens because the assessment usually is given at high cognitive order while discussions in class and practices didn't give the opportunity to the student to develop the needed understanding. So, misalignment can be a great source of frustration in the learning environment which is the main responsibility of the teacher or curriculum designer to make sure the alignment is observed.

After the discussion made on the alignment between learning objectives and assessment strategies in the Environmental Science book, we need to mention quickly the responsibility of teachers and their importance in the learning process. We may design the best learning outcomes and align them with most creative and highest level of the cognitive skills but without a good and creative teacher, all these lose their values. This is why in addition to alignment, teacher's growth and development in the best practice of teaching is the a very important asset.

Shulman (1987) classified the process of a teacher growth into categories of the knowledge base. We quote these categories from his book *'Knowledge and teaching: Foundations of the new reform'*:

- content knowledge;
- general pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;

- curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers;
- pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;
- knowledge of learners and their characteristics;
- knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
- knowledge of educational ends, purposes, and values, and their philosophical and historical grounds'. (Shulman 1987 p.8)

The ability to incorporate and to teach environmental concepts requires not only content knowledge but also skills of how to teach the concepts. In the book of *'Learning that Lasts: Integrating learning, development and performance in college and beyond'*, competency refers to the suitability of a professional for a discipline and '[…] define[s] the knowledge, skills, and attitudes needed to function successfully within the discipline' (Mentkowski M. Associates 2000). Dilmore et al. (2013) defines the competency-based education (CBE) as a learning paradigm that focuses on 'describing and measuring what learners need to know and be able to do (outcomes), given the goals and mission of the program' (Dilmore, Moore & Bjork 2013).

Unfortunately, ongoing discussions about basic competences for EE teachers are invading the Literature.

The insufficient quality of teacher education to support EE and ESD are reported in several studies and ongoing discussions about basic competences for teachers are noted. For example, and as evoked in the UNECE framework, there is a description of teacher education in Austria as a 'conglomerate of unconnected knowledge'. Teaching and learning competencies, which are a prerequisite for

educational quality, are receiving less attention compared to domain knowledge, such as biology, geography, etc. and often, "the content of a course is strongly influenced by the lecturer's preference and is not necessarily oriented towards the future praxis of the teacher student" (UNECE 2008).

In an attempt to study the EE preservice teacher preparation in universities, we observe that the treatment of EE is often shallow. As it is well recognized that insufficient content and practical knowledge leads to inappropriate teaching practices (Gruenewald 2004), consequently and in later stages of their carrier, teachers are finding themselves unconfident to enter the classrooms and to implement EE pedagogical methodologies (McKeown-Ice 2010). These findings were reported in a study done at the University of Jyväskylä in Finland in 2015 to determine student-teachers' practical knowledge in the context of teaching climate change in elementary schools. It was found that 'student-teachers knew the appropriate teaching strategies even for dialogic teaching, but unfortunately they did not know how these should be enacted in the classroom' (Ilkka et al. 2015). Thus, many teacher educators around the world could not perceive the EE as part of the mainstream school curriculum and unfortunately, many K-12 school curriculum fail to integrate EE (McKeown-Ice, R., 2010).

Dramatically, and as asserted by Sadler and Donnelly (2006), teachers in schools are addressing sciences by using traditional educational practices based on their own evaluation of subject importance and with a merely absence of transfer of knowledge and learning outside the school. This logical linear method used by teachers is failing to acquire students the necessary dimensions needed for decision making toward scientific and social problems they face or they might face in the future. Within this context, the dual integration of EE in preservice and in-service science teacher preparation appears to be fundamental.

In an analysis to enhance environmental literacy in China, and recognizing that EE is not at the top priority of the school agenda in China, Sun (2014) found that "Rather than modify[ing]

environmental education to survive in schools, it is more productive and promising to advance the ongoing curriculum reform so that it raises hope for a further greening of the curriculum" (Sun 2014 p.24). On the other hand, teaching the curriculum through cross curricular models that use the environment as 'an integrating context for teaching and learning, and as a way of connecting learning to government, community groups, resources, and issues' (Alberta Council for Environmental Education- ACEE, 2010) was strongly advised by the Alberta Council for Environmental Education. Some barriers facing the inclusion of EE in preservice teacher education programs at universities were noted and were mainly attributed to the lack of faculty knowledge about EE, and/or the inflexible structure of preservice teacher education courses and/or the lack of EE standards in teacher accreditation and certification requirements and/or the curriculum time constraints in the teacher education curriculum (McKeown-Ice 2010).

Over and over, the level of environmental awareness is differing quietly among teachers. Teachers working in private schools are found to have higher levels of environmental awareness as compared to those working in government schools (Larijani 2010). Additionally, the literature carried out contradictory findings regarding the relationship between teacher gender and environmental awareness. Larijani (2010) found female teacher to have higher levels of environmental awareness compared to male teachers whereas Badkobi and Hadipour (2001) reported higher levels of awareness among male teachers. In contrast, Jinarajan (1999) did not find any gender difference in environmental awareness in his study whereas no significant differences were observed in environmental education awareness among senior secondary school teachers in relation to type of school and gender by Vipinder & Sandeep (2013).Moreover, the lack of competences and differences in environmental awareness among teachers pointed out furthermore on the necessity of a paradigm

reform in the educational system from school to university and on the urgent need to enroll teachers, male and female equally, in advanced training on environment related aspects.

A positive and significant correlation exists between environmental education awareness and ecological behavior of secondary school teachers (Vipinder & Rajneesh 2014). Therefore, integrating EE in the educational system will allow teachers of tomorrow to acquire teaching and learning strategies needed to achieve the cognitive, affective, and behavioral goals of EE and will help their students in becoming environmentally literate (Bodzin et al. 2010). An urged by necessity of involving teachers in continuous professional development programs in all their carrier stages is discussed as well. Indeed, Professional Development (PD) will allow educators to acquire necessary competencies, teaching skills and methodologies in order to explore the nature of the science and its relation with the society and the environment (Zeidler, Walker, Acket & Simmons (2002) and Tekzoz et al. (2010). Because of the holistic approach needed in EE, competencies and professional development in education are key determinants for an effective and successful transformation at the institutional level. A significant need of training teachers so that students of both can develop their critical thinking skills and act positively towards environment is of great value (Yousuf and Bhutta 2012). Three areas of teachers' competencies were defined by the Organization for Economic Co-operation and Development (OECD):

1. Competences for the interactive use of tools, such as knowledge, media and resources;
2. Competences for acting autonomously;
3. Competences for interacting within socially heterogeneous groups.

In the UNESCO report ‘Learning: the treasure within’ (UNESCO 1996), Delors recognizes four pillars of education in the 21st Century: learning to know, learning to do, learning to be and learning to live together. These fundamental pillars appear to correspond as well with the frequently used competence fields: domain competences, methodological competences, personal competences and social competences (UNECE 2008).

Advanced Placement Environmental Science (APES) is well integrated in the secondary school curriculum, reviewed every year or two to incorporate updated environmental examples to foster analytical and critical thinking regarding environmental issues and to apply quantitative methods for analysis (Goodwin 2003, p. 2). Teachers of APES are in general instructors of biology, chemistry, earth science, physics, or any combination of these disciplines; some schools have pointed out a special APES teaching position. The course content for APES was not taken from any existing environmental science text; consequently, teachers are invited to develop their personal course syllabus, select their textbook, follow their own teaching style and incorporate laboratory and field experiences. To support professional development for AP teachers, the College Board developed AP Central, the online home of AP professionals and the Pre-AP™ program providing up-to-date information on the AP Program and APES, including course descriptions, sample free-response questions and scoring guidelines, sample syllabi, and feature articles written by AP teachers.

5.4 Implications

Socio-scientific issues rely upon scientific knowledge, reasoning and the ability to negotiate evidence in order to take decisions. Students are invited to reflect on their own beliefs and defend their opinions during the process of learning the environment. Understanding how students think regarding the moral and ethical context of socio-scientific issues in general and environmental issues in particular, will allow science teachers to acquire and incorporate teaching strategies aiming at

developing students' reasoning skills in these crucial areas. These findings were reflected in the investigation on the 'relationships between students' conceptions of the nature of science and their reactions to evidence that challenged their beliefs about socio-scientific issues' that Zeidler et al. (Zeidler et.al 2002).

These researchers have found that students' reactions to anomalous socio-scientific data are varied and complex. Conceptions of the nature of science were being reflected in students' reasoning on a moral and ethical issue and notable differences in the reasoning processes between high school students and college students were reported.

5.5 limitations

It is always good to look at the full picture when considering the learning process in any school. Unfortunately, a lot of obstacles can face researchers when they want to investigate a certain aspect in the learning and teaching processes. A lot of institutions will refuse to conduct the study while others may accept but try to influence the results toward their benefit. Book choice as well is another obstacle, in this study we checked only the book that is currently in use. We didn't investigate how a school or curriculum committees choose the books for the courses offered in their schools. A lot of criteria can be considered when considering such process. May be further studies can be about the process of choosing a textbook for a certain course.

5.6 Concluding note

This study sheds the light on a very narrow aspect of environmental science education. It investigated only one element and discussed some factors affecting the process of learning in environmental science. We conclude that 'It is not sufficient to «tell» students about ecology. Students must experience a curriculum which allows them to discover how they interact with the environment themselves. Only in this way will citizens the world over be able to make sound and responsible decisions concerning environmental issues.' (UNESCO, 1994). Our future on this earth relies between the hands of our future generations so we need to prepare them in the best way. "If we want children to flourish, to become truly empowered, let us allow them to love the earth before we ask them to save it." (Sobel, D. 1995). We provide them with the best weapon to defend the future of our human race and our environment as Nelson Mandela says: "Education is the most powerful weapon you can use to change the world."

References

References

Altin, A., Tecer, S., Tecer, L., Altin, S. & Kahraman, B.F. (2014). *Environmental Awareness Level of Secondary School Students: A Case Study in Balıkesir (Türkiye)*. 4th World Conference on Learning Teaching and Educational Leadership (WCLTA-2013) . *Social and Behavioral Sciences* [online], Vol.141. pp. 1208-1214. [Accessed 3 December 2016]. Available at: http://www.sciencedirect.com/science/article/pii/S1877042814036313.

Anderson, L. and Krathwohl, D. (2001). A Taxonomy for Learning, Teaching, and Assessing. Longman: New York.

Alberta Council for Environmental Education (ACEE). (2010). *Guiding principles for designing new provincial curricula in Alberta* [online]. [Accessed 8 February 2017]. Available at: http://www.abcee.org/cms/wp-content/uploads/2010/10/Guiding-principles-for-curriculum-that-support-environmental-education.pdf.

Arvai, J. L., Campbell, V. E.A., Baird, A. & Rivers, L. (2004). Teaching Students to Make Better Decisions about the Environment: Lessons from the Decision Sciences. *Journal of Environmental Education* [online]. (36) (1), p33. [Accessed 7 February 2017]. Available at: https://eric.ed.gov/?id=EJ709782.

Atkins, M., Beattie, J. and Dockrell, B. (1993) Assessment Issues in Higher Education.

Auwalu, R. A. (2015). Influence of School Location on Environmental Awareness Level among Secondary School Students in Terengganu. Malaysia. *IOSR Journal of Environmental Science. Toxicology and Food Technology* [online]. 9 (3) (2), pp. 54-61. DOI: 10.9790/2402-09335461. [Accessed 22 November 2016]

Badkobi, A. & Hadipour, M. (2001). Assessment of primary school teacher's educational condition in different zones of Tehran Municipality in Environmental subjects and the ways of elevating their Awareness. *Scientific Quarterly Journal Environment*. vol. 33, pp. 79- 80.

Bärlund, K. (2004). Sustainable development - concept and action. United Nations Economic Commission for Europe (UNECE) [online]. [Accessed 2 October 2016]. Available at: http://www.unece.org/oes/nutshell/2004-2005/focus_sustainable_development.html.

Baxter, G., Elder, A. & Glaser, R. (1996). Knowledge-based cognition and performance assessment in the science classroom. Educational Psychologist [online]. Vol. 31 (2), pp. 133-140. [Accessed 10 March 2017]. Available at: http://www.tandfonline.com/doi/pdf/10.1207/s15326985ep3102_5

Benavot, A. (2014). Education for sustainable development in primary and secondary education. Background paper. DESC Unit-UNESCO [online]. [Accessed 14 February 2017]. Available at: http://www.academia.edu/7891812/Education_for_Sustainable_Development_in_Primary_and_Secondary_Education.

Bhola, D., Impara, J. & Buckendahl, C. (2005). Aligning Tests with States' Content Standards: Methods and Issues. Educational Measurement: Issues and Practice [online]. Vol. 22 (3), pp. 21-29.

[Accessed 12 May 2017]. Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1745-3992.2003.tb00134.x/pdf

Biggs, J. (2002) "Aligning teaching and assessment to curriculum objectives". http://www.heacademy.ac.uk/assets/York/documents/resources/resourcedatabase/id477_aligning_teaching_for_constructing_learning.pdf [accessed March 2009].

Biggs, J. & Tang, C. (2011). Teaching for Quality Learning at University. Maidenhead, UK:SRHE & Open University Press.

Biggs, J. (1996). Enhancing teaching through constructive alignment. Higher Education[online]. Vol. 32 (3), pp. 347-364. [Accessed 12 May 2017]. Available at: https://link.springer.com/article/10.1007/BF00138871

Bloom, B. (1956). Taxonomy of educational objectives. N.Y.:Longmans, Green

Blumstein, D.T. & Saylan, C. (2007).The Failure of Environmental Education (and How We Can Fix It). *PLoS Biol* [online]. vol. 5 (5). [Accessed 3 February 2017]. doi:10.1371/journal.pbio.0050120.

Bodzin, A. Shiner, K. B. Weaver, S. (eds). (2010). The Inclusion of Environmental Education in Science Teacher Education. Springer [online]. [Accessed 22 January 2017]. Available at: DOI 10.1007/978-90-481-9222-9.

Breiting, S. Mayer, M. & Mogensen, F. (2005). Quality criteria for ESD-schools: Guidelines to enhance the quality of education for sustainable development. SEED - Austrian Federal Ministry of

Education [online]. [Accessed 28 February 2017]. Available at: http://www.ensi.org/global/downloads/Publications/208/QC-GB.pdf.

Broom, C. (2010). *Curriculum in the Age of Globalization*. ERIC [online]. [Accessed 12 January 2017]. Available at: http://files.eric.ed.gov/fulltext/EJ916616.pdf.

Burgess, J. Harrison, C.M. & Filius, P. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning A* [online]. vol. 30, pp. 1445 -1460. [Accessed 10 January 2017]. Available at: http://journals.sagepub.com/doi/pdf/10.1068/a301445.

Burgess, D.J. & Mayer-Smith, J. (2011). Listening to children: Perceptions of nature. *Journal of Natural History Education and Experience* [online]. vol. 5, pp. 27- 43. [Accessed 29 November 2016]. Available at: http://naturalhistorynetwork.org/wp-content/uploads/2011/10/Burgess-and-Mayer-Smith.v5.27-43.pdf.

Burroughs, J. (2000). Field and Study. Boston: Houghton Mifflin. [Viewed 29 November 2016]. http://www.ebooksread.com/authors-eng/john-burroughs/field-and-study-rru/1-field-and-study-rru.shtml.

California Education and the Environment Initiative. 2016. *EEI Curriculum Catalog: Increasing Environmental Literacy for K–12 Students… Because the Future is in Their Hands* [online]. [Accessed 28 February 2017]. Available at: http://www.californiaeei.org/media/1072/curriculum-catalog.pdf.

Chadwick, S. (2004). Curriculum development in orthodontic specialist registrar training: can orthodontics achieve constructive alignment?. J Orthodon, (31), pp. 267–74.

Chalkley, B. (2006). Education for sustainable development: Continuation. *Journal of Geography in Higher Education* [online]. vol. 30(2), pp. 235-236.

Conde, M.C. & Sánchez, J.S. (2010). *International Journal of Environmental & Science Education* [online]. vol. 5 (4), pp. 477- 494. [Accessed 12 January 2017]. Available at: http://files.eric.ed.gov/fulltext/EJ908944.pdf.

Grossman, J. & Cawn, B. (2017). Ambitious Leadership: A Case Study of Aligning Math Curriculum to College and Career Ready Standards. Newleaders.org [online]. [Accessed 2 February 2017]. Available at: http://newleaders.org/wp-content/uploads/2016/12/CaseStudy3-DCBilingual-Curriculum.pdf

Crowe, A., Dirks, C. & Wenderoth, M. (2008). Biology in Bloom: Implementing Bloom's Taxonomy to Enhance Student Learning in Biology. Cell Biology Education [online]. Vol. 7 (4), pp. 368-381. [Accessed 9 March 2017]. Available at: http://www.lifescied.org/content/7/4/368.full

Dambudzo, I.I. (2014). Curriculum Issues: Teaching and Learning for Sustainable Development in Developing Countries: Zimbabwe Case Study. *Journal of Education and Learning* [online]. vol. 4 (1). [Accessed 28 February 2017]. Available at: http://files.eric.ed.gov/fulltext/EJ1075158.pdf.

Dilmore, T.C. Moore, D.W. & Bjork, Z. (2013). Developing a Competency-Based Educational Structure within Clinical and Translational Science. *Clinical and Translational Science* [online]. vol. 6, pp. 98–102. [Accessed 21 January 2017]. Available at: doi:10.1111/cts.12030.

Dubai Municipality- Environmental Awareness Section- Environment Department. Dubai Municipality Role in Environmental Education and Awareness in Dubai. *Envirocities eMagazine* [online]. Issue 9, pp. 21-28. [Accessed 28 October 2016]. Available at: http://en.envirocitiesmag.com/articles/issue-9/Art4.pdf.

diSessa, A.A., Gillespie, N., & Esterly, J. (2004). Coherence versus fragmentation in the development of the concept of force. Cognitive Science, 28, 843-900.

Ehrenfeld, D. (2003). Globalisation: Effects on Biodiversity. *Environment and Society Conservat Soc* [online]. Vol.1, pp. 99-111. [Accessed 12 January 2017]. Available at: http://www.conservationandsociety.org/text.asp?2003/1/1/99/49362.

Eilam, E. & Trop, T. (2012). Environmental Attitudes and Environmental Behavior—Which Is the Horse and Which Is the Cart?. *Sustainability* [online]. vol.4, pp. 2210-2246. [Accessed 2 March 2017]. Available at: doi: 10.3390/su4092210.

Einstein, A. (1946). Atomic Education Urged by Einstein. *New York Times* [online], 25 May 1946. [Accessed 29 December 2016]. Available at: http://wist.info/einstein-albert/207/.

Evagorou, M. (2011). ‘Discussing a socio-scientific issue in a primary school classroom: The case of using a technology supported environment in formal and nonformal settings’, in Sadler, T.D. (eds). Socio-scientific Issues in the classroom: Teaching. Learning and Research. Dordrecht: Springer. vol.39, pp.133-159.

Feierabend, T. & Eilks, I. (2010). Raising students' perception of the relevance of science teaching and promoting communication and evaluation capabilities using authentic and controversial socio-scientific issues in the framework of climate change. *Science Education International*. vol. 21, pp.176-196.

Fuhrman, S. (2001). From the capitol to the classroom. Chicago:National Society for the Study of Education.

Galanter, E. (1966). Textbook of elementary psychology. San Francisco:Holden-Day.

Goodwin, D. (2003) College Entrance Examination Board AP® Environmental Science Teacher's Guide [online]. [Accessed 16 January 2017]. Available at: http://apcentral.collegeboard.com/apc/members/repository/ap07_envsci_teachersguide.pdf.

Global Environmental Education Partnership (GEEP). (n.d.). United Arab Emirates EE in K-12 Education [online]. [Accessed 28 October 2016]. Available at: http://thegeep.org/country-profiles/united-arab-emirates.

Gopal, G. V. & Anand V.V. (n.d.). Environmental Education in school Curriculum an overall perspective. Regional institute of education Mysore [online]. [Accessed 1 November 2016]. Available at: http://wgbis.ces.iisc.ernet.in/energy/lake2006/programme/programme/proceedings/fullpaper_pdfs/Gopal_V%20V%20Anaad.pdf.

Grimmette, K. A. (2014). *The Impacts of Environmental Education on Youth and their Environmental Awareness* [online]. Ph.D. Thesis. University?????? Environmental Studies Undergraduate Student Theses Paper 135. [Accessed 29 November 2016]. Available at: http://digitalcommons.unl.edu/envstudtheses/135.

Gruenewald, A. D. (2004). *A Foucauldian Analysis of Environmental Education: Toward the Socioecological Challenge of the Earth Charter*. The Ontario Institute for Studies in Education of the University of Toronto Curriculum Inquiry [online], vol. 34. (1). [Accessed 23 January 2017]. Available at: http://earthcharter.org/invent/images/uploads/Gruenewald.%20D.%20A%20Foucaldian%20analysis%20of%20EE.pdf.

Gulf News, (2005). http://gulfnews.com/news/uae/general/shaikh-zayed-in-quotes-1.306268

Gulf News. (2008). *New-environmental Education Programme launched in UAE*. Gulf News Education Section [online]. [Accessed 28 October 2016]. Available at: http://gulfnews.com/news/uae/education/new-environmental-education-programme-launched-in-uae-schools-1.138062.

Harold, R. Hungerford, R. H. Volk, L. T. & Ramsey, M. J. (1994). A Prototype Environmental Education Curriculum for the Middle School: A discussion Guide for UNESCO Training Seminars on Environmental Education. UNESCO – UNEP International Environmental Education Programme. Environmental Education Unit Science and Environmental Education Section. Division for the Renovation of Educational Curricula and Structures [online], Series 29. [Accessed 10 November 2016). Available at: http://www.unesco.org/education/pdf/333_49.pdf.

Hart, P. (2007). 'Environmental Education'. in Abell, S.K. & Lederman, N.G. (Eds.). Handbook of Research on Science Education. Mahwah. NJ: Lawrence Erlbaum Associates. pp. 689-726.

Harris, J. Mishra, P. & Koehler, M. (2009). Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types: Curriculum-based Technology Integration Reframed. *Journal of Research on Technology in Education (JRTE)* [online]. Vol, 41 (4). pp. 393–416. [Accessed 28 February 2017]. Available at: http://files.eric.ed.gov/fulltext/EJ844273.pdf.

Haury, LD. (2002). Teaching about Ecosystems. Columbus OH: Eric Clearinghouse for Science Mathematics and Environmental Education [online]. [Accessed 2 October 2016]. Available at: http://www.ericdigests.org/2004-1/ecosystems.htm.

Huba, M. & Freed, J. (2000). Learner-centered assessment on college campuses. Boston:Allyn and Bacon.

Hungerford, HR & Volk, T. (1990). Changing Learner Behavior through Environmental Education. [online], pp. 257-270. [Accessed 2 March 2017]. Available at:

http://www.elkhornsloughctp.org/uploads/files/1374624954Changing%20learner%20behavior%20-%20H%20and%20V.pdf.

Iltus, S. (2012). Climate Change and Environmental Education: A companion to the Child Friendly Schools Manual - Child Friendly Schools Manual. United Nations Children's Fund (UNICEF) Division of Communication. [online], [Accessed 3rd November 2016]. Available at: https://www.unicef.org/publications/files/CFS_Climate_E_web.pdf

Ilkka, R.I. Jouni, V.J. Lehesvuori, S. & Kokkonen, T. (2015). Primary Student-Teachers' Practical Knowledge of Inquiry-Based Science Teaching and Classroom Communication of Climate Change. *International Journal of Environmental & Science Education* [online], vol. 10 (5). pp 649-670. [Accessed 17 January 2017]. Available at: http://files.eric.ed.gov/fulltext/EJ1081841.pdf.

Institute for Global Environmental Strategies (IGES). (2001). Environmental Education: Report of the first Phase Strategic Research. [Online]. [Accessed 4th November 2016]. Available at: https://pub.iges.or.jp/system/files/publication_documents/pub/business/762/1036-tokatsu.pdf

Inter-Agency Commission WCEFA (UNDP, UNESCO, UNICEF & World Bank). (1990). Final Report of the World Conference on Education for All: Meeting Basic Learning Needs [online]. [Accessed 28 November 2016]. Available at: http://www.unesco.org/education/pdf/11_93.pdf.

Jickling B. & Wals, E.J. A. (2008). Globalization and environmental education: looking beyond sustainable development. *Journal Of Curriculum Studie*s [online]. Vol. 40 (1). [Accessed 3

November 2016]. Available at: http://www.tandfonline.com/doi/full/10.1080/00220270701684667?src=recsys).

Jinarajan, S. (1999). A study of Environmental Awareness and Attitude towards Environmental Education of Student Teachers of Bangalore City. M. Phil. Dissertation. Department of Education. Bangalore University.

The Kansas Association for Conservation and Environmental Education (KACEE). 2010. 'Kansas Environmental Literacy Plan' [online]. [Accessed 10 October 2016]. Available at: http://www.kacee.org/files/ELP%20for%20KS%20Final.pdf.

Kasimov, N. Malkhazova, S. & Romanova, E. (2015). The Role of Environmental Education for Sustainable Development in Russian Universities. *Taylor & Francis Online* [online]. pp. 24-25. [Accessed 2 October 2016]. Available at: http://www.tandfonline.com/doi/full/10.11120/plan.2002.00080024

Kinghorn, R. J. (1987). Environmental Education- Methods & Approaches. Earth Rights - Education as if the Planet really Mattered. Published for WWF UK by the Centre for Global Education. University of York [online]. [Accessed 4 February 2017]. Available at: http://www.teindia.nic.in/mhrd/50yrsedu/q/6J/AY/6JAY0301.htm.

Kollmus, A. & Agyeman, J. (2002). Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental Education Research* [online]. Vol. 8 (3).

[Accessed 2 March 2017]. Available at: http://psychsustain.voices.wooster.edu/files/2014/01/Mind-Gap.pdf.

Kopnina, E. (2011). Education for sustainable development (ESD): the turn away from 'environment' in environmental education?'. *Environmental Education Research* [online]. vol. 18 (5), pp. 699-717. [Accessed 22 November 2016)
Available at: http://www.tandfonline.com/doi/full/10.1080/13504622.2012.658028?src=recsys.

Krathwohl, D. (2002). A Revision of Bloom's Taxonomy: An Overview. Theory Into Practice, vol. 41 (4), pp. 212-218. [Accessed 14 April 2016].

Krathwohl, D. (2002). A Revision of Bloom's Taxonomy: An Overview. Theory Into Practice, 41(4), pp.212-218.

Larijani, M. (2010). Assessment of Environmental Awareness among Higher Primary School Teachers. *Journal of Human Ecology* [online]. vol. 31 (2), pp 121-124. [Accessed 28 November 2016]. Available at: http://krepublishers.com/02-Journals/JHE/JHE-31-0-000-10-Web/JHE-31-2-000-10-Abst-PDF/JHE-31-2-121-10-2040-Larijani-M/JHE-31-2-121-10-2040-Larijani-M-Tt.pdf.

Littledyke, M. (2002). Primary children's views on science and environmental issues: examples of environmental cognitive and moral development. University of Gloucestershire. in: European Conference on Educational Research. University of Lisbon. pp. 11-14. [Accessed 13 January 2017]. Available at: http://www.leeds.ac.uk/educol/documents/00002338.htm

Makki, M. Abd-El-Khalick, F. & Boujaoude, S. (2003). *Lebanese secondary school students' environmental knowledge and attitudes*. Environmental Education Research. vol. 9 (1), pp 21-33.

Mayer, R. (2002). Rote Versus Meaningful Learning. Theory Into Practice [online]. Vol. 41 (4), pp. 226-232. [Accessed 11 May 2017]. Available at: http://web.mit.edu/jrankin/www/teach_transfer/rote_v_meaning.pdf

McKeown-Ice, R. (2010). Environmental Education in the United States: A Survey of Preservice Teacher Education Programs. *The Journal Of Environmental Education* [online]. vol. 32 (1). [Accessed 21 January 2017]. Available at: http://dx.doi.org/10.1080/00958960009598666.

Mentkowski M. Associates. (2000). Learning that lasts: Integrating learning. Development and performance in college and beyond. San Francisco: Jossey-Bass.

Meredith, J. Cantrell, D. & Conner, M. (2000). Best Practices for Environmental Education: Guidelines for Success. *Environmental Education Council of Ohio* [online]. p. 5. [Accessed 6 October 2016]. Available at: http://www.epa.state.oh.us/other/oeef/oeemain.html.

Ministry of Climate Change and Environment, UAE. 2015. National Environmental Education & Awareness Strategy 2015-2021, [online]. [Accessed 1 March 2017]. Available at: http://www.moccae.gov.ae/assets/b4a14e05/national-environmental-education-and-awareness-strategy-2015-2021-en.aspx.

Moukhallati, D. (2015). Schoolchildren targeted in Dubai environmental awareness campaign. The National UAE [online]. [Accessed 28 October 2016]. Available at: http://www.thenational.ae/uae/education/schoolchildren-targeted-in-dubai-environmental-awareness-campaign.

Murat, G. (2015).The Project-based learning approach in environmental education. *Journal of International Research in Geographical and Environmental Education* [online]. vol.24 (2). [Accessed 21 January 2017]. Available at: http://www.tandfonline.com/doi/full/10.1080/10382046.2014.993169.

Mwendwa, B. (2017). Learning for Sustainable Development: Integrating Environmental Education in the Curriculum of Ordinary Secondary Schools in Tanzania. *The Journal of Sustainability Education* [online]. [Accessed 22 February 2017]. Available at: http://www.jsedimensions.org/wordpress/content/learning-for-sustainable-development-integrating-environmental-education-in-the-curriculum-of-ordinary-secondary-schools-in-tanzania_2017_02/.

Napoleon, L., Freedman, D., Seetharaman, K. & Sharma, P. (2006). An Educational Needs Assessment of Pennsylvania Workforce: Opportunities to Redefine Secondary Career and Technical Education to Meet Food Industry Needs. Journal of Food Science Education [online]. Vol. 5 (2), pp. 19-23. [Accessed 4 March 2017]. Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1541-4329.2006.tb00077.x/abstract

Nasser, R., Zaki, E., Allen, N., Al Mula, B., Al Mutawaha, F., Ali, H. & Kerr, T. (2014). Alignment of Teacher-Developed Curricula and National Standards in Qatar's National Education Reform.

International Education Studies [online]. Vol. 7 (10). [Accessed 9 April 2017]. Available at: http://www.ccsenet.org/journal/index.php/ies/article/view/33720

Näsström, G. (2008). Measurement of Alignment between Standards and Assessment. phD. UMEA.

The National Environmental Education Advisory Council. (2005). Setting the Standard. Measuring the results. Celebrating Success - A report to Congress on the Status of Environmental Education in the United States [online]. [Accessed 4 January 2017]
Available at: https://www.epa.gov/sites/production/files/documents/reporttocongress2005_2.pdf.

O'Malley, S. (2015). The Relationship between Children's Perceptions of the Natural Environment and Solving Environmental Problems. Development Education and Climate Change [online]. Issue 21. [Accessed 23November 2016]. Available at: https://www.developmenteducationreview.com/issue/issue-21/relationship-between-childrens-perceptions-natural-environment-and-solving

Omran, M.S. & Yarmohammadian, M.H. (2015). Designing environmental literacy curriculum for secondary school education system in Iran: Using an integrated approach. *Int J Educ Psychol Res* [online]. vol. 1, pp. 113- 118. [Accessed 12 February 2017]. Available at: http://www.ijeprjournal.org/text.asp?2015/1/2/113/152224

Omoogun, A. C. & Odok, A. O. (2013). Influence of Gender and Environmental Awareness on Attitude of People towards Forest Conservation in Ekuri Communities in Akamkpa Local Government Area of Cross River State. *Journal of Public Administration and Governance Macrothink Institute* [online]. vol. 3 (2). [Accessed 5 November 2016]
DOI: 10.5296/jpag.v3i2.3984.

Ontario Ministry of Education. (2006). Standards for Environmental Education in the Curriculum [online]. [Accessed 7 December 2016]. Available at: http://www.edu.gov.on.ca/curriculumcouncil/Env_Ed_Standards.pdf.

Ontario Ministry of Education. (2009). Acting Today. Shaping Tomorrow: A policy Framework for Environmental Education in Ontario Schools. [online]. [Accessed 6 December 2016]. Available at: http://lsf-lst.ca/media/ShapeTomorrow.pdf?phpMyAdmin=27c4ca48e56t67ceba5e.

Ontario Ministry of Education. (2011). Ontario Schools Kindergarten to grade 12 Policy and Program Requirements [online]. [Accessed 6 December 2016]. Available at: http://www.edu.gov.on.ca/eng/document/policy/os/ONSchools.pdf.

Özmen, H. & Karamustafao, O. (2006). Environmental consciousness and education relationship: Determination of how environment-based concepts are placed in Turkish science curricula. *Asia-Pacific Forum on Science Learning and Teaching* [online]. vol.7 (2). [Accessed 27 November 2016]. Available at: https://www.ied.edu.hk/apfslt/download/v7_issue2_files/ozmen.pdf.

Packaging Recovery Organization Europe (ProEurope). (2005). *Environmental Education: the path to Sustainable Development*. Belgium: ProEurope [online]. Available at: http://www.pro-e.org/files/environmental_education.pdf. [Accessed 2 October 2016]

Popham, J. (2004). Test better, teach better: the instructional role of assessment. Choice Reviews Online [online]. Vol. 42 (01), pp. 42-0445-42-0445. [Accessed 6 April 2016]. Available at: http://www.ascd.org/publications/books/102088.aspx

Phye, G. (1997). Handbook of classroom assessment: learning, achievement, and adjustment. Choice Reviews Online [online]. Vol. 34 (10), pp. 34-5809-34-5809. [Accessed 7 June 2017]. Available at: http://www.sciencedirect.com/science/book/9780125541558

Rajasekar, S., Philominathan, P. & Chinnathambi, V. (2017). RESEARCH METHODOLOGY. 13th edn. Viewed 9 February 2017. https://arxiv.org/pdf/physics/0601009.pdf

Roach, A., Niebling, B. & Kurz, A. (2008). Evaluating the alignment among curriculum, instruction, and assessments: Implications and applications for research and practice. Psychology in the Schools [online]. Vol. 45 (2), pp. 158-176. [Accessed 12 May 2017]. Available at: http://onlinelibrary.wiley.com/doi/10.1002/pits.20282/abstract

"Revised Bloom's Taxonomy – CELT". (2017). [Accessed 29 February 2017]. Available at: http://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy

Sadler, T. & Donnelly, L. (2006). Socio-scientific argumentation: The effects of content knowledge and morality. *International Journal of Science Education* [online]. vol. 28 (12), pp.1463-1488. [Accessed 7 February 201]. Available at: http://dx.doi.org/10.1080/09500690600708717.

Sadler, T. & Murakami, C. (2014). Socio-scientific Issues based Teaching and Learning: Hydrofracturing as an Illustrative context of a Framework for Implementation and Research. University of Missouri [online]. [Accessed 2 February 2017]. Available at: https://seer.ufmg.br/index.php/rbpec/article/view/2713/2079.

Salem, M.H. & Mohammed Al Refaei, M. (2014). Environmental Education Initiatives - Ministry of Education - UAE. Envirocities eMagazine [online]. Issue 2. [Accessed 28 October 2017]. Available at: http://en.envirocitiesmag.com/articles/issue-9/Art8.pdf.

Sandelowski, M. (2000). Whatever happened to qualitative description?. Research in Nursing & Health [online]. Vol. 23 (4), pp. 334-340. [Accessed 4 April 2017]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/10940958

Sandeep, P. & Sanjivani, M. (2013). Teacher Education for Sustainable Development: Empowering Teachers for Future. *Global Online Electronic International Interdisciplinary Research Journal (GOEIIRJ)* [online]. Special Issue (1), p.127. [Accessed 23 January 2016]. Available at: http://www.goeiirj.com/upload/mar2013/21.pdf.

Saylan, C. & Blumstein, D. T. (2011). The Failure of Environmental Education (and how we can fix it)'. *University of California Press*.

Shafer, L. (2015). *Teaching the Environment: How educators can help students understand the complexity of environmental change*. Harvard Graduate School of Education [online]. [Accessed 8 February 2017]. Available at: https://www.gse.harvard.edu/news/uk/15/12/teaching-environment.

Schreiner, C & Sjøberg, S. (2004). 'Empowered for action? How do young people relate to environmental challenges?' in Alsop, S. (eds). Beyond Cartesian Dualism: Encountering Affect in the Teaching and Learning of Science. *Science & Technology Education Library* [online]. Vol. 29. Chapter 11. Springer Netherlands. [Accessed 3 October 2016]. Available at: http://www.roseproject.no/network/countries/norway/eng/nor-schreiner-springer2004.pdf.

Shah, R. (n.d.). Environmental Education (EE): Objectives. Principles and Programmes. BiologyDiscussion [online]. [Accessed 4 February 2017]. Available at: http://www.biologydiscussion.com/environment/environmental-education-ee-objectives-principles-and-programmes/16779.

Sherren, K. (2005). Balancing the disciplines: A multidisciplinary perspective on sustainability curriculum content. *Australian Journal of Environmental Education* [online]. vol. 21, pp.97-106. [Accessed 2 February 2017]. Available at: https://www.cambridge.org/core/journals/australian-journal-of-environmental-education/article/div-classtitlebalancing-the-disciplines-a-multidisciplinary-perspective-on-sustainability-curriculum-contentdiv/3B0BD605A1267A3F7B72FDB8E4AFE317.

Sherren, K. (2008). A history of the future of higher education for sustainable development. *Environmental Education Research* [online]. vol. 14(3), pp. 238-256.

Shepard, K. (2007). Higher education for sustainability: seeking affective learning outcomes. Higher Education Development Centre, University of Otago –Dunedin, New Zealand [online]. [Accessed 5 February 2017]. Available at: http://202.116.45.198/kcyjxl/jxtj/pdf/6/3.Higher%20education%20for%20sustainability-%20seeking%20affective%20learning%20outcomes.pdf.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review* [online]. vol. 57(1), pp.1-22. [Accessed 21 January 2017] Available at: http://tltjc.blogspot.com/2011/04/shulman-1987-knowledge-and-teaching-pck.html.

Sivamoorthy, M. Nalini, R. & Satheesh, K. C. (2013). Environmental Awareness and Practices among College Students. *International Journal of Humanities and Social Science Invention* [online], pp. 2319 – 7722. ISSN (Print): 2319 – 7714. www.ijhssi.org. 2(8). 11-15. [Accessed 7th July 2016]

Sjøberg, S. & Schreiner, C. (2010). The ROSE project. Overview and key finding. University of Oslo [online]. [Accessed 5 January 2017]. Available at: http://roseproject.no/network/countries/norway/eng/nor-Sjoberg-Schreiner-overview-2010.pdf.

Smith, R. (2012). Alignment of intended learning outcomes, curriculum and assessment in a middle school science program. PhD. Edith Cowan University.

Smith, M. & O'Day, J. (1990). Systemic school reform. Journal of Education Policy [online]. Vol. 5 (5), pp. 233-267. [Accessed 7 May 2017]. Available at: http://www.cpre.org/sites/default/files/policybrief/847_rb06.pdf

Stone, J. M. (1989). Preparing teachers to become involved as environmental educators. Contemporary Education [online]. vol.60 (3), pp. 159–162. Eric online. [Accessed 15 January 2016]. Available at: https://eric.ed.gov/?id=EJ414166.

Sun, L. (2014). From rhetoric to practice: enhancing environmental literacy of pupils in China. Freudenthal Institute for Science and Mathematics Education. Faculty of Science. Utrecht University / FIsme Scientific Library (formerly published as CD-β Scientific Library). no. 81. 2014.

Taylor, P. C. 2014. Contemporary Qualitative Research. *Handbook of Research on Science Education Routledge* [online]. [Accessed 23 January 2017]. Available at: https://www.routledgehandbooks.com/doi/10.4324/9780203097267.ch3

Teksoz, G. Sahin, E. & Ertepinar, H. (2010). A new vision for chemistry education students: Environmental education. *International Journal of Environmental & Science Education* [online]. vol. 5(2), pp.131-149. [Accessed 8 November 2016). Available at: http://files.eric.ed.gov/fulltext/EJ884415.pdf.

UNECE. (2008). Competencies for ESD (Education for Sustainable Development) teachers: A framework to integrate ESD in the curriculum of teacher training institutes. Comenius 2.1 project 118277-CP-1-2004-BE [online]. [Accessed 3 October 2016]. Available at:

http://www.unece.org/fileadmin/DAM/env/esd/inf.meeting.docs/EGonInd/8mtg/CSCT%20Handbook_Extract.pdf.

UNESCO. (1975). The Belgrade Charter: A framework for Environmental Education [online]. [Accessed 23 October 2016]. Available at: http://unesdoc.unesco.org/images/0001/000177/017772eb.pdf.

UNESCO. (1977). Tbilisi Declaration [online]. [Accessed 7 January 2017]. Available at: http://www.gdrc.org/uem/ee/tbilisi.html.

UNESCO. (2012). Education for Sustainable Development (ESD): Sourcebook for teachers - For decision-makers responsible for primary and secondary education. Learning & Training Tools [online]. vol. 4. [Accessed 15 February 2017]. Available at: http://unesdoc.unesco.org/images/0021/002163/216383e.pdf.

UNESCO- UNEP Environmental Education Program. (1975). The International Workshop on Environmental Education. Final Report ED-76/WS/95 [online]. [Accessed 7 November 2016] Available at: http://unesdoc.unesco.org/images/0002/000276/027608eb.pdf.

United Nations (UN). (1992). United Nations Conference on Environment & Development- Rio de Janerio-Brazil, Agenda 21 [online]. [Accessed 27 November 2016). Available at: https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf.

Uzunöz, A. (2011). Reliability and validity towards environment attitude scale for secondary school students. *Educational Research and Reviews* [online]. vol. 6. (16). pp. 893-901. [Accessed 3 October 2016]. Available at: http://academicjournals.org/journal/ERR/article-full-text-pdf/43D284C7572.

Volk, T. (1998). 'Integration and Curriculum Design'. in Hungerford, H.R. Bluhm, W.J. Volk, T.L. & Ramsey, J.M. (eds.). *Essential Readings in Environmental Education* [online]. [Accessed 3 November 2016]. Available at: https://eric.ed.gov/?id=ED440821.

Vipinder, N. & Sandeep, S. (2013). Environmental education awareness among senior secondary school teachers. *International Journal of Behavioral Social and Movement Science* [online]. vol. 2 (1). [Accessed 28 November 2016]. Available at: http://www.ijobsms.in/vol02%20issue01%202013%20p28.pdf.

Vipinder, N & Rajneesh, K. P. (2014). Environmental Education Awareness and Ecological Behaviour of School Teachers. *Asian Journal of Multidisciplinary Studies* [online]. Vol. 2 (11). [Accessed 30 November 2016]. Available at: http://www.ajms.co.in/sites/ajms2015/index.php/ajms/article/view/699.

Waks, L. J. (2003). How globalization can cause fundamental curriculum change: an American perspective. *Journal of Educational Change* [online]. vol. 4 (4), pp. 383–418. [Accessed 12 January 2017]. Available at: https://pdfs.semanticscholar.org/bc6a/94fa90a524b73ec593854de13624d3e0ce18.pdf

Webb, N. (2002). An analysis of the alignment between mathematics standards and assessments for three states. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, USA. [Accessed 7 March 2017].

Webster, J. & Watson, R. (2002). Analyzing the past to prepare for the future: writing a literature review. MIS [online]. Vol. 26 (2), p. Xiii-Xxiii. [Accessed 15 May 2017]. Available at: https://misq.org/misq/downloads/download/editorial/176/

Wheeler, G. & Vavrus, J. (2014). Washington State K-12 Integrated Environmental and Sustainability Education Learning Standards. Version 1.2 [online]. [Accessed 28 November 2016]. Available at: http://www.k12.wa.us/EnvironmentSustainability/pubdocs/ESEStandards.pdf.

Withgott, J. & Laposta, M. (2015). Environment, the Science Behind the stories. 5th edn. England:Pearson Education Limited.

Woodhouse, J. Knapp, L. Clifford, E. (2000). Place-Based Curriculum and Instruction: Outdoor and Environmental Education Approaches. ERIC Digest [online]. [Accessed 2 February 2017]. Available at: http://files.eric.ed.gov/fulltext/ED448012.pdf.

World Commission on Environment and Development (WCED). (1987). Our Common Future. Oxford: Oxford University Press [online]. [Accessed 3 October 2016]. Available at: http://www.un-documents.net/our-common-future.pdf.

Yildiz, Y. (n.d.). Developing Students' Environmental Awareness by Curricular and extracurricular activities. Ishik University - Department of Languages [online]. [Accessed 28 December 2016]. Available at: http://www.academia.edu/8447872/Developing_Students_Environmental_Awareness_by_Curricular_and_Extracurricular_activities.

Yousuf, A. & Bhutta, S. (2012). Secondary School Students' Attitude towards Environmental Issues in Karachi Pakistan. *Journal of Educational and Social Research* [online]. vol. 2 (10), p.154. [Accessed 2 October 2016]. Available at: Doi:10.5901/jesr.2012.v2n10p154.

Zhang, Y., & Wildemuth, B. M. (2009) Qualitative analysis of content. In B. Wildemuth (Ed.), Applications of social research methods to questions in information and library science (pp. 308-319). Westport, CT: Libraries Unlimited.

Zeidler, D. Walker, K. Ackett, W. & Simmons, M. (2002). Tangled Up in Views: Beliefs in the Nature of Science and Responses to Socioscientific Dilemmas. *Science Education Journal* [online]. vol. 83(3), pp.343-368. [Accessed on 7th February 2016]. Available at: http://dx.doi.org/10.1002/sce.10025.

Zo'bi, A. S. (2014). The Effect of Using Socio-Scientific Issues Approach in Teaching Environmental Issues on Improving the Students' Ability of Making Appropriate Decisions towards These Issues. *International Education Studies* [online]. vol.7 (8), pp. 113-123. [Accessed on 7 February 2017]. Available at: DOI: 10.5539/ies.v7n8p113.

Zoller, U. (1993). Are lecture and learning compatible? Maybe for LOCS: Unlikely for HOCS. Journal of Chemical Education, 70(3), p.195.

Bibliography

Bibliography

- American Association for the Advancement of Science (AAAS). 2013. *Benchmarks for Science Literacy:* A tool for curriculum reform. [Online], Available at: http://www.project2061.org/publications/bsl/. [Accessed 3 March 201]

- Aminrak Z. et al. 2010. Environmental Awareness and Attitude among Iranian Students in Malaysian Universities, [Online], Available at: https://www.researchgate.net/publication/281147295_Environmental_Awareness_Level_amongst_Secondary_School_Students_in_Terengganu_Malaysia_Based_on_Different_Variables, [Accessed 3 December 2016)

- Bryan, A. 2015. Guest Editorial: Development Education, Climate Change and the 'Imperial Mode of Living': 'Thinking Institutionally about the Ecological Crisis, Policy & Practice. Center for Global Education [online]. Vol. 21, pp.1-10. [Accessed 28 October 2016]. Available at: https://www.developmenteducationreview.com/issue/issue-21/relationship-between-childrens-perceptions-natural-environment-and-solving.

- California State Superintendent of Public Instruction Tom Torlakson's statewide Environmental Literacy Task Force (ELTF). 2015. A Blueprint for Environmental Literacy: Educating Every Student In, About, and For the Environment', Californians Dedicated to Education Foundation, [Online], Available at:http://www.cde.ca.gov/pd/ca/sc/documents/environliteracyblueprint.pdf. [Accessed 2 March 2017]

- Dahiya N. and Ritu. 2013. A Study of Environmental Awareness and Attitude towards Environmental Degradation of Senior Secondary School Students', *International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)*. Vol. 2, no. 1. [Online]. Available at: http://www.ijemhs.com/Published%20Paper/Volume%2002/Issue%2001/IJES%2004/IJEMHSDec13_15_26_Neelam_Ritu.pdf. [Accessed 23 September 2016]

- Fortier D J, Grady M S, Lee S A and Marinac A P. 1998.Wisconsin's Model Academic Standards for Environmental Education, Wisconsin Department of Public Instruction, [Online], Available at: https://dpi.wi.gov/sites/default/files/imce/standards/pdf/envired.pdf. [Accessed 3 March 2017]

- Gopinath G. 2014. A Study on The Environmental Awareness Among Secondary School Students in a District of Kerala State, *International Journal of Education and Psychological Research (IJEPR)*. Vol. 3, no. 2. [Online]. Available at: http://ijepr.org/doc/V3_Is2_June14/ij11.pdf. [Accessed 22 September 2016]

- North American Association for Environmental Education (NAAEE). Guidelines for Excellence: Best Practice in EE', NAAEE website. [online]. Available at: https://naaee.org/eepro/publication/guidelines-excellence-series-set. [Accessed 3 March 2017]

- Office of Superintendent of Public Instruction. 2009 Updated 2014. Washington State K-12 Integrated Environmental and Sustainability Education Standards. [online]. Available at: http://www.k12.wa.us/EnvironmentSustainability/Standards/default.aspx. [Accessed 8 March 2017]

- Withgott, J. & Laposta, M. (2015). Environment, the Science Behind the stories. 5th edn. England:Pearson Education Limited.

Appendices

Appendix A

Scans of Learning objectives and assessments from the textbook used in the study.

"Environment, The Science Behind the Stories"

Source :

Withgott, J. & Laposta, M. (2015). Environment, the Science Behind the stories. 5th edn. England:Pearson Education Limited.

http://assets.pearsonglobalschools.com/file-vault/trytexas/img/samples/ApSolutions/Student/environment/WithgottEnvSci.pdf

Testing Your Comprehension

1. What does the study of ethics encompass? Describe and differentiate instrumental value and intrinsic value. What is environmental ethics?
2. Compare and contrast anthropocentrism, biocentrism, and ecocentrism. Explain how individuals with each perspective might evaluate the development of a shopping mall atop a wetland in your town or city.
3. Differentiate the preservation ethic from the conservation ethic. Explain the contributions of John Muir and Gifford Pinchot in the history of environmental ethics.
4. Describe Aldo Leopold's land ethic. How did Leopold define the "community" to which ethical standards should be applied?
5. Define the concept of environmental justice. Give an example of an inequity relevant to environmental justice that you believe exists in your city, state, or country.
6. Describe the ways in which a nation's attitude toward environmental issues might be shaped by economics.
7. Briefly, weigh the Cornucopian and Cassandran economic positions in relation to their environmental views.
8. Compare and contrast the views of neoclassical economists, environmental economists, and ecological economists, particularly regarding the issue of economic growth.
9. What is contingent valuation, and what is one of its weaknesses? Describe an alternative method that avoids this weakness.
10. How can sustainable development be defined? What is meant by the triple bottom line? Why is it important to pursue sustainable development?

Seeking Solutions

1. Describe your worldview as it pertains to your relationship with your environment. How do you think your culture has influenced your worldview? How do you think your personal experience has affected it? How do you think your worldview shapes your decisions? Do you feel that you fit into any particular category discussed in this chapter? Why or why not?
2. Visit the U.S. EPA's online tool for assessing environmental justice concerns, at http://epamap14.epa.gov/ejmapentry.html, and enter your city, county, or zip code. On the map page, check the six types of "Sites reporting to EPA" in the list of features on the right, and let it plot these on the map. Now click on "Demographics." Apply various demographic layers one by one, including at least "Per Capita Income," "Below Poverty (%)," and "Minority (%)." The site will map these parameters and show how the EPA-regulated facilities are located relative to them.

   What patterns do you see? Where are most facilities located, relative to wealth, race, and other factors? What do you think accounts for the patterns you find? Do you perceive any problems revealed by these data? What could be done to alleviate such problems?
3. Do you think that a steady-state economy is a practical alternative to our current approach that prioritizes economic growth? Why or why not?
4. Do you think we should attempt to quantify and assign market values to ecosystem services and other entities that have only nonmarket values? Why or why not?
5. Suppose you are a Costa Rican farmer who needs to decide whether to clear a stand of forest or apply to receive payments to preserve it through the PSA program. Describe all the types of information you would want to consider before making your decision. Now, describe what you think each of the following people would recommend to you if you were to go to them for advice:
   - a preservationist
   - a conservationist
   - a neoclassical economist
   - an ecological economist
6. **THINK IT THROUGH** A manufacturing facility on a river near your home provides jobs for 200 people in your community of 10,000 people, and it pays $2 million in taxes to the local government each year. Sales taxes from purchases made by plant employees and their families contribute an additional $1 million to local government coffers. However, newspaper reports and recent peer-reviewed studies in well-respected scientific journals reveal that the plant has been discharging large amounts of waste into the river, causing a 25% increase in cancer rates, a 30% reduction in riverfront property values, and a 75% decrease in native fish populations.

   The plant owner says the facility can stay in business only because there are no regulations mandating expensive treatment of waste from the plant. If such regulations were imposed, he says he would close the plant, lay off its employees, and relocate to a more business-friendly community.

   How would you recommend resolving this situation? What further information would you want to know before making a recommendation? In arriving at your recommendation, how did you weigh the costs and benefits associated with each of the plant's impacts?

Reviewing Objectives

You should now be able to:

Characterize the influences of culture and worldview on the choices people make

- Culture and personal experience influence a person's worldview. (p. 153)
- Factors such as religion, political ideology, and shared experiences shape our perspectives on the environment and the choices we make. (p. 153)

Outline the nature and historical expansion of ethics in Western culture

- Environmental ethics applies ethical standards to relationships between people and aspects of their environments. (p. 154)
- We can value things for utilitarian reasons (instrumental value) or for their own sake (intrinsic value). (p. 154)
- Our society's domain of ethical concern has been expanding, and we have granted more and more entities ethical standing. (pp. 154–155)
- Anthropocentrism values people above all else, whereas biocentrism values all life, and ecocentrism values ecological systems. (p. 155)
- The industrial revolution inspired philosophical reactions that fed into environmental ethics. (p. 156)

Compare major approaches in environmental ethics

- The preservation ethic, espoused by John Muir, values preserving natural systems intact. (p. 156)
- The conservation ethic, espoused by Gifford Pinchot, promotes responsible long-term use of resources. (pp. 156–157)
- The philosophy of Aldo Leopold, including his land ethic, has deeply influenced modern environmental ethics. (pp. 157–158)
- Environmental justice seeks equal treatment for people of all income levels, races, and ethnicities. (pp. 158–159)

Explain how our economies exist within the environment and rely on ecosystem services

- Economies depend on the ecological systems around them for natural resources and ecosystem services. (p. 160)
- Ecosystem services, provided for free by nature, enable our economies to prosper. The degradation of ecosystem services threatens our economic well-being. (pp. 160–161)

Describe principles of classical and neoclassical economics and summarize their implications for the environment

- Classical economics proposes that individuals acting for their own economic good can benefit society as a whole. This view has provided a philosophical basis for free-market capitalism. (p. 161)
- Neoclassical economics focuses on supply and demand and quantifies costs and benefits. (pp. 161, 164)
- Four assumptions of neoclassical economics tend to worsen environmental impacts. (pp. 164–165)
- Conventional economic theory promotes infinite economic growth, with little regard to potential environmental impact, despite the fact that resource consumption cannot rise indefinitely. (pp. 165–168)

Illustrate aspects of environmental economics and ecological economics

- Environmental economists advocate reforming economic practices to promote sustainability. Ecological economists agree but advocate going further by pursuing a steady-state economy. (p. 168)
- Assigning monetary value to ecosystem goods and services can help reduce external costs and make market prices reflect full costs and benefits. (pp. 168–170)
- Full cost accounting indicators aim to measure economic progress and human well-being more effectively than GDP. (pp. 170–172)

Describe how individuals and businesses can help move our economic system in a sustainable direction

- Consumer choice in the marketplace, facilitated by eco-labeling, can encourage businesses to pursue sustainable practices. (p. 173)
- Many corporations are modifying their operations to become more sustainable, and this often is financially profitable. (pp. 173–174)

Explain the pursuit of sustainable development

- Sustainable development promotes people's economic advancement while using resources in a way that satisfies today's needs without compromising the needs of future generations. (p. 174)
- Advocates of sustainable development pursue environmental, economic, and social goals in a coordinated way. (pp. 174–175)
- Sustainable development has thrived as a global movement on the international stage. (p. 175)

Reviewing Objectives

You should now be able to:

Describe the nature of environmental systems

- Earth's natural systems are complex, so environmental scientists often take a holistic approach to studying environmental systems. (p. 124)
- Systems are networks of interacting components that generally involve feedback loops, show dynamic equilibrium, and result in emergent properties. (pp. 124–125)
- Negative feedback stabilizes systems, whereas positive feedback destabilizes systems. Positive feedback often results from human disturbance of natural systems. (pp. 124–125)
- Because environmental systems interact and overlap, one's delineation of a system depends on the questions in which one is interested. (p. 126)
- Hypoxia in the Chesapeake Bay, which results from nutrient pollution in the rivers that feed it, illustrates how systems are interrelated. (p. 126)

Define ecosystems and evaluate how living and nonliving entities interact in ecosystem-level ecology

- Ecosystems consist of all organisms and nonliving entities that occur and interact in a particular area at the same time. (pp. 128–129)
- Energy flows in one direction through ecosystems, whereas matter is recycled. (pp. 128–129)
- Energy is converted to biomass, and ecosystems vary in their productivity. (pp. 129–130)
- Input of nutrients can boost productivity, but an excess of nutrients can alter ecosystems and cause severe ecological and economic consequences. (pp. 129–131)

Outline the fundamentals of landscape ecology, GIS, and ecological modeling

- Landscape ecology studies how landscape structure influences organisms. (pp. 131–132)
- Landscapes consist of patches spatially arrayed in a mosaic. Organisms dependent on certain types of patches may occur in metapopulations. (pp. 131–132)
- With the help of remote sensing technology and GIS, landscape ecology is being increasingly used in conservation and regional planning. (pp. 132–133)
- Ecological modeling helps ecologists make sense of the complex systems they study. (pp. 133–134)

Assess ecosystem services and how they benefit our lives

- Ecosystems provide the "goods" we know of as natural resources. (p. 134)

- Ecological processes naturally provide services that we depend on for everyday living. (pp. 134–135)

Compare and contrast how water, carbon, nitrogen, and phosphorous cycle through the environment

- A source is a reservoir that contributes more of a material than it receives, and a sink is one that receives more than it provides. (p. 135)
- Water moves widely through the environment in the water cycle. (pp. 138–139)
- Most carbon is contained in sedimentary rock. Substantial amounts also occur in the oceans and in soil. Carbon flux between organisms and the atmosphere occurs via photosynthesis and respiration. (pp. 139–141)
- Nitrogen is a vital nutrient for plant growth. Most nitrogen is in the atmosphere, so it must be "fixed" by specialized bacteria or lightning before plants can use it. (pp. 141, 144)
- Phosphorus is most abundant in sedimentary rock, with substantial amounts in soil and the oceans. Phosphorus has no appreciable atmospheric reservoir. It is a key nutrient for plant growth. (p. 145)

Explain how human impact is affecting biogeochemical cycles

- People are affecting Earth's biogeochemical cycles by shifting carbon from fossil fuel reservoirs into the atmosphere, shifting nitrogen from the atmosphere to the planet's surface, and depleting groundwater supplies, among other impacts. (pp. 139–146)
- Policy can help us address problems with nutrient pollution. (p. 146)

Testing Your Comprehension

1. What is the difference between a positive and a negative feedback loop? Explain what happens when a system is in dynamic equilibrium.
2. List four ways in which humans have altered the water cycle. What are the major concerns for the future?
3. What is the difference between an ecosystem and a community?
4. Describe the typical movement of energy through an ecosystem. Now describe the typical movement of matter through an ecosystem.
5. Explain net primary productivity. Name one ecosystem with high net primary productivity and one with low net primary productivity.
6. Why are patches in a landscape mosaic often important to people who are interested in conserving populations of rare animals?
7. What is the difference between evaporation and transpiration? Give examples of how the water cycle interacts with the carbon, phosphorus, and nitrogen cycles.
8. Give a brief overview of the carbon cycle. Include the source of carbon that enters ecosystems, how it moves through ecosystems, what it is used for, and where it is ultimately deposited. What part of this cycle is believed to contribute to global warming?
9. Distinguish the function performed by nitrogen-fixing bacteria from that performed by denitrifying bacteria.
10. How has human activity altered the carbon cycle? The phosphorus cycle? The nitrogen cycle? What environmental problems have arisen from these changes?

Seeking Solutions

1. Once vegetation is cleared from a riverbank, water begins to erode the bank away. This erosion may dislodge more vegetation. Would you expect this to result in a feedback process? If so, which type—negative or positive? Explain your answer. How might we halt or reverse this process?
2. Consider the ecosystem(s) that surround(s) your campus. Describe one way in which energy flows through and matter is recycled. Now pick one type of nutrient, and briefly describe how it moves through your ecosystem(s). Does the landscape contain patches? Can you describe any ecotones?
3. For a conservation biologist interested in sustaining populations of the organisms below, why would it be helpful to take a landscape ecology perspective? Explain your answer in each case.
   - A forest-breeding warbler that suffers poor nesting success in small, fragmented forest patches
   - A bighorn sheep that must move seasonally between mountains and lowlands
   - A toad that lives in upland areas but travels cross-country to breed in localized pools each spring

4. A simple change in the flux between just two reservoirs in a single nutrient cycle can potentially have major consequences for ecosystems and, indeed, for the entire Earth. Explain how this can be, using one example from the carbon cycle and one example from the nitrogen cycle.
5. How do you think we might solve the problem of eutrophication in the Chesapeake Bay? Assess several possible solutions, your reasons for believing they might work, and the likely hurdles we might face. Explain who should be responsible for implementing these solutions, and why.
6. **THINK IT THROUGH** You are an oysterman in the Chesapeake Bay, and your income is decreasing because the dead zone is making it harder to harvest oysters. One day your senator comes to town, and you have a one-minute audience with her. What steps would you urge her to take in Washington, D.C., to try to help alleviate the dead zone and bring back the oyster fishery?

   Now suppose you are a Pennsylvania farmer who has learned that the government is offering incentives to farmers to help reduce fertilizer runoff into the Chesapeake Bay. What types of approaches described in the text might you be willing to try, and why?

Calculating Ecological Footprints

In the United States, a common dream is to own a suburban home with a weed-free green lawn. Nationwide, Americans tend about 40.5 million acres of lawn grass. But conventional lawn care involves inputs of fertilizers, pesticides, and irrigation water, and using gasoline or electricity for mowing and other care—all of which raise environmental and health concerns. Using the figures for a typical lawn in the table, calculate the total amount of fertilizer, water, and gasoline used in lawn care across the nation each year.

	Acreage of lawn	Fertilizer used (lbs)	Water used (gal)	Gasoline used (gal)
For the typical 1/4-acre lawn	0.25	37	16,000	4.9
For all lawns in your hometown				
For all lawns in the United States	40,500,000			

Data from Charnetski, B., 2008. http://www.nicholas.duke.edu/thegreengrok/lawns.

1. How much fertilizer is applied each year on lawns throughout the United States? Where does the nitrogen for this fertilizer come from? What becomes of the nitrogen and phosphorus applied to a suburban lawn that is not taken up by grass?
2. Leaving grass clippings on a lawn decreases the need for fertilizer by 50%. What else might a homeowner do to decrease fertilizer use in a yard and the environmental impacts of nutrient pollution?
3. How much gasoline could Americans save each year if they did not take care of lawns? At today's gas prices, how much money would this save?

- We are developing sustainable solutions that promote our quality of life while protecting and restoring our environment. (p. 34)

Articulate the concept of sustainability and describe campus sustainability efforts

- Sustainability means living within our planet's means, such that Earth's resources can sustain us—and all life—for the future. (p. 32)

- Your environmental science course will help prepare you for the challenges and opportunities in a world striving for a sustainable future. (pp. 35–36)

Testing Your Comprehension

1. What do renewable resources and nonrenewable resources have in common? How are they different? Identify two renewable and two nonrenewable resources.
2. How and why did the agricultural revolution affect human population size? How and why did the industrial revolution affect human population size? Explain what benefits and what environmental impacts have resulted.
3. What is an *ecological footprint*? Explain what is meant by the term *overshoot*.
4. Define environmental science and environmentalism. How are they different? Explain the similarities between the two.
5. What are the two meanings of *science*? Name three applications of science.
6. Describe the scientific method. What is its typical sequence of steps?
7. What is a natural experiment? Name the challenges of performing a natural experiment as opposed to a manipulative experiment?
8. What needs to occur before a researcher's results are published? Why is this process important?
9. Give examples of three major environmental problems in the world today, along with their causes. How are these problems interrelated? Can you name a potential solution for each?
10. What qualities are present in a sustainable enterprise?

Seeking Solutions

1. Many resources are renewable if we use them in moderation but can become nonrenewable if we overexploit them. Order the following resources on a continuum of renewability (see Figure 1.1), from most renewable to least renewable: soils, timber, fresh water, food crops, and biodiversity. What factors influenced your choices? For each resource, what might constitute overexploitation, and what might constitute sustainable use?
2. What do you think is the lesson of Easter Island? What more would you like to learn or understand about this island and its people? What similarities do you perceive between the history of Easter Island and the modern history of our society? What differences do you see between their predicament and ours?
3. What environmental problem do you feel most acutely yourself? Do you think there are people in the world who do not view your issue as a problem? Who might they be, and why might they take a different view?
4. If the human population were to stabilize tomorrow and never reach 8 billion people, would that solve our environmental problems? Which types of problems might get better, and which might become worse?
5. Find out what sustainability efforts are being made on your campus. What results have these efforts produced so far? What further efforts would you like to see pursued on your campus? Do you foresee any obstacles to these efforts? How could these obstacles be overcome? How could you become involved?
6. **THINK IT THROUGH** You have become head of a major funding agency that disburses funding to scientists pursuing research in environmental science. You must give your staff several priorities to determine what types of scientific research to fund. What environmental problems would you most like to see addressed with research? Describe the research you think would need to be completed so that workable solutions to these problems could be developed. What else, beyond scientific research, might be needed to develop sustainable solutions?

Appendix B

Evaluation Tool

Available at:

https://www.cmu.edu/teaching/resources/Teaching/CourseDesign/TeacherAssessment/Knowl-CogProcDimension.pdf

4.1 THE KNOWLEDGE DIMENSION

MAJOR TYPES AND SUBTYPES	EXAMPLES
A. FACTUAL KNOWLEDGE—The basic elements students must know to be acquainted with a discipline or solve problems in it	
Aa. Knowledge of terminology	Technical vocabulary, music symbols
Ab. Knowledge of specific details and elements	Major natural resources, reliable sources of information
B. CONCEPTUAL KNOWLEDGE—The interrelationships among the basic elements within a larger structure that enable them to function together	
Ba. Knowledge of classifications and categories	Periods of geological time, forms of business ownership
Bb. Knowledge of principles and generalizations	Pythagorean theorem, law of supply and demand
Bc. Knowledge of theories, models, and structures	Theory of evolution, structure of Congress

C. PROCEDURAL KNOWLEDGE—How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods	
CA. Knowledge of subject-specific skills and algorithms	Skills used in painting with water colors, whole-number division algorithm
CB. Knowledge of subject-specific techniques and methods	Interviewing techniques, scientific method
CC. Knowledge of criteria for determining when to use appropriate procedures	Criteria used to determine when to apply a procedure involving Newton's second law, criteria used to judge the feasibility of using a particular method to estimate business costs

D. METACOGNITIVE KNOWLEDGE—Knowledge of cognition in general as well as awareness and knowledge of one's own cognition	
DA. Strategic knowledge	Knowledge of outlining as a means of capturing the structure of a unit of subject matter in a text book, knowledge of the use of heuristics
DB. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Knowledge of the types of tests particular teachers administer, knowledge of the cognitive demands of different tasks
DC. Self-knowledge	Knowledge that critiquing essays is a personal strength, whereas writing essays is a personal weakness; awareness of one's own knowledge level

CATEGORIES & COGNITIVE PROCESSES	ALTERNATIVE NAMES	DEFINITIONS AND EXAMPLES
1. REMEMBER—Retrieve relevant knowledge from long-term memory		
1.1 RECOGNIZING	Identifying	Locating knowledge in long-term memory that is consistent with presented material (e.g., Recognize the dates of important events in U.S. history)
1.2 RECALLING	Retrieving	Retrieving relevant knowledge from long-term memory (e.g., Recall the dates of important events in U.S. history)

2. UNDERSTAND—Construct meaning from instructional messages, including oral, written, and graphic communication		
2.1 INTERPRETING	Clarifying, paraphrasing, representing, translating	Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents)
2.2 EXEMPLIFYING	Illustrating, instantiating	Finding a specific example or illustration of a concept or principle (e.g., Give examples of various artistic painting styles)
2.3 CLASSIFYING	Categorizing, subsuming	Determining that something belongs to a category (e.g., Classify observed or described cases of mental disorders)
2.4 SUMMARIZING	Abstracting, generalizing	Abstracting a general theme or major point(s) (e.g. Write a short summary of the event portrayed on a videotape)
2.5 INFERRING	Concluding, extrapolating, interpolating, predicting	Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples)
2.6 COMPARING	Contrasting, mapping, matching	Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations)
2.7 EXPLAINING	Constructing models	Constructing a cause-and-effect model of a system(e.g., explain the causes of important 18th Century events in France)

3. APPLY—Carry out or use a procedure in a given situation		
3.1 EXECUTING	Carrying out	Applying a procedure to a familiar task (e.g., Divide one whole number by another whole number, both with multiple digits)
3.2 IMPLEMENTING	Using	Applying a procedure to an unfamiliar task (e.g., Use Newton's Second Law in situations in which it is appropriate)

CATEGORIES & COGNITIVE PROCESSES	ALTERNATIVE NAMES	DEFINITIONS AND EXAMPLES
4. ANALYZE—Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose		
4.1 DIFFERENTIATING	Discriminating, distinguishing, focusing, selecting	Distinguishing relevant from irrelevant parts or important from unimportant parts of presented material (e.g., Distinguish between relevant and irrelevant numbers in a mathematical word problem)
4.2 ORGANIZING	Finding coherence, intergrating, outlining, parsing, structuring	Determining how elements fit or function within a structure (e.g., Structure evidence in a historical description into evidence for and against a particular historical explanation)
4.3 ATTRIBUTING	Deconstructing	Determine a point of view, bias, values, or intent underlying presented material (e.g., Determine the point of view of the author of an essay in terms of his or her political perspective)
5. EVALUATE—Make judgments based on criteria and standards		
5.1 CHECKING	Coordinating, detecting, monitoring, testing	Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented (e.g., Determine if a scientist's conclusions follow from observed data)
5.2 CRITIQUING	Judging	Detecting inconsistencies between a product and external criteria, determining whether a product has external consistency; detecting the appropriateness of a procedure for a given problem (e.g., Judge which of two methods is the best way to solve a given problem)
6. CREATE—Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure		
6.1 GENERATING	Hypothesizing	Coming up with alternative hypotheses based on criteria (e.g., Generate hypotheses to account for an observed phenomenon)
6.2 PLANNING	Designing	Devising a procedure for accomplishing some task (e.g., Plan a research paper on a given historical topic)
6.3 PRODUCING	Constructing	Inventing a product (e.g., Build habitats for a specific purpose)

3.1 THE TAXONOMY TABLE

THE KNOWLEDGE DIMENSION	THE COGNITIVE PROCESS DIMENSION					
	1. REMEMBER	2. UNDERSTAND	3. APPLY	4. ANALYZE	5. EVALUATE	6. CREATE
A. FACTUAL KNOWLEDGE						
B. CONCEPTUAL KNOWLEDGE						
C. PROCEDURAL KNOWLEDGE						
D. META-COGNITIVE KNOWLEDGE						

Appendix C:

Bloom's Taxonomy Action verbs

Bloom's Taxonomy Action Verbs

Level	Definition	Sample verbs					Sample behaviors
KNOWLEDGE	Student recalls or recognizes information, ideas, and principles in the approximate form in which they were learned.	arrange define describe duplicate	identify label list match	memorize name order outline	recognize relate recall repeat	reproduce select state	The student will define the 6 levels of Bloom's taxonomy of the cognitive domain.
COMPREHENSION	Student translates, comprehends, or interprets information based on prior learning.	explain summarize paraphrase describe illustrate classify	convert defend describe discuss distinguish estimate explain	express extend generalized give example(s) identify indicate	infer locate paraphrase predict Recognize	rewrite review select summarize translate	The student will explain the purpose of Bloom's taxonomy of the cognitive domain.
APPLICATION	Student selects, transfers, and uses data and principles to complete a problem or task with a minimum of direction.	use compute solve demonstrate apply construct	apply change choose compute demonstrate discover dramatize	employ illustrate interpret manipulate modify operate	practice predict prepare produce relate schedule	show sketch solve use write	The student will write an instructional objective for each level of Bloom's taxonomy.
ANALYSIS	Student distinguishes, classifies, and relates the assumptions, hypotheses, evidence, or structure of a statement or question	analyze categorize compare contrast separate apply	change discover choose compute demonstrate dramatize	employ illustrate interpret manipulate modify operate	practice predict prepare produce relate schedule	show sketch solve use write	The student will compare and contrast the cognitive and affective domains.
SYNTHESIS	Student originates, integrates, and combines ideas into a product, plan or proposal that is new to him or her.	create design hypothesize invent develop arrange assemble	categorize collect combine comply compose construct create	design develop devise explain formulate generate plan	prepare rearrange reconstruct relate reorganize revise	rewrite set up summarize synthesize tell write	The student will design a classification scheme for writing educational objectives that combines the cognitive, affective, and psychomotor domains.
EVALUATION	Student appraises, assesses, or critiques on a basis of specific standards and criteria.	Judge Recommend Critique Justify Appraise Argue	Assess Attach Choose Compare Conclude Contrast	Defend Describe Discriminate Estimate Evaluate Explain	Judge Justify Interpret Relate Predict	Rate Select Summarize Support Value	The student will judge the effective-ness of writing objectives using Bloom's taxonomy.

Reference: http://chiron.valdosta.edu/whuitt/col/cogsys/bloom.html

Source:

file:///C:/Users/Patrick/Desktop/Last%20week%20of%20June%20m1/References/Blooms%20Level.pdf