USAID FROM THE AMERICAN PEOPLE | JORDAN

Survey Finding of the Mapping Concepts of Water, Energy Conservation and Solid Waste Management in the Jordanian National Curriculum. Formal Sector, Final Report

Public Action for Water, Energy and Environment Project
Prosperity, Livelihoods and Conserving Ecosystems (PLACE) IQC Task Order #5

Report no. 9

May 2010

This report was produced for review by the United States Agency for International Development. It was prepared by ECODIT for **Public Action Project for Water, Energy and Environment project**, Task Order No. EPP-I-05-06-00010-00.

AUTHORITY

Prepared for USAID/Jordan under Prosperity, Livelihoods and Conserving Ecosystems (PLACE) Indefinite Quantity Contract number EPP-I-05-06-00010-00, Task Order #05, awarded September 1, 2009, entitled "Public Action for Water, Energy and Environment Project."

This report is made possible by the support of the American People through the United States Agency for International Development (USAID). The contents of this report are the sole responsibility of ECODIT and do not necessarily reflect the views of USAID or the United States Government.

PREFACE

The Public Action for Water, Energy and Environment Project (PAP) is a public education and behavior change communication program developed to support USAID's technical and policy investments in the Jordanian water and energy sectors, and to support specific initiatives in the environment, in particular with regard to solid waste. The project has been awarded to ECODIT, a US small business holding the Prosperity, Livelihoods and Conserving Ecosystems, or PLACE, Indefinite Quantity Contract with USAID.

PAP is a five years program that has been designed in three phases:

1. Data collection and assessment phase of 9 months ending July 31, 2010;
2. Participatory strategic planning phase of 3 months that will include dialogue with the relevant stakeholders; and
3. Implementation phase lasting about 4 years.

The first phase of the project (Assessment and Baseline Phase) is to be completed by the summer of 2010. As part of this phase, ECODIT is conducting numerous surveys, including 12 or more research efforts, and it is from the totality of these efforts that the project will determine its direction and focus for behavioral change. ECODIT has divided this phase into the several rapid assessments. In addition to this survey of Mapping concepts of Water and Energy Conservation and Solid Waste Management in the National Jordanian Curriculum which was prepared by world of letters, other surveys of Young People's Knowledge Attitudes and Behaviors - Gaps on Environmental Education In the Formal Sector, Young People's Knowledge Attitudes and Behaviors on Environmental Issues: Water and Energy Conservation and Solid Waste Management. In the informal and non formal sectors, Water and Energy Related Interviews for Large Jordanian Consumers, KAP household, donors, NGOs/CBOs, commercial outlets, governmental institutions including ministries, municipalities and utilities, and educational programs are on-going.

The objective of this study is to evaluate the concepts of water, energy and solid waste that exist in the curriculum and the manner in which they are tackled. To achieve that, the World of Letters team is mandated to map current textbooks based on the three themes of the study: water, energy and solid waste. In order to develop a holistic approach, the three themes are categorized under six main environmental education principles. These principles form the conceptual framework, based on which the mapping is conducted. Mapping was carried out by 14 educationalists. Each concept mapped was classified under the environmental education objectives of knowledge, attitude, skills, participation and ethics. A comprehensive survey of 104 school textbooks from grades 1-10 in fourteen subjects was conducted.

TABLE OF CONTENT

PREFACE III

TABLE OF CONTENT IV

FIGURES VI

EXECUTIVE SUMMARY VII

1.0 INTRODUCTION 10
1.1 PROJECT BACKGROUND AND OBJECTIVES 10
1.2 RESEARCH METHODOLOGY 11
1.3 CONCEPTUAL FRAMEWORK 12

2.0 RESULTS OF TEXTBOOK MAPPING 13
2.1 SOCIAL STUDIES (GRADES 1-10) 13
Recommendations: 13
2.2 HISTORY (GRADES 1-10) 14
Recommendations: 14
2.3 GEOGRAPHY (GRADES 6-10) 15
Recommendations: 15
2.4 SCIENCE (GRADES 1-8) 16
Recommendations: 17
2.5 BIOLOGY (GRADES 9-10) 17
Recommendations: 18
2.6 CHEMISTRY (GRADES 9-10) 18
Recommendations: 19
2.7 PHYSICS (GRADES 9-10) 19
Recommendations: 19
2.8 GEOLOGY (GRADES 9-10) 21
Recommendations: 21
2.9 ISLAMIC EDUCATION 22
Recommendations: 22
2.10 ENGLISH 23
Recommendations: 24
2.11 ARABIC 24
Recommendations: 25
2.12 MATHEMATICS (GRADES 1-10) 25
Recommendations: 26
2.13 ART (GRADES 8-10) 26
Recommendations: 26
2.14 VOCATIONAL EDUCATION (GRADES 1-10) 26
Recommendations: 27

3.0 SCOPE AND SEQUENCE CHART RESULTS 28

3.1 THEME-BASED RESULTS 28
3.2 GENERAL RESULTS 29
3.3 RESULTS BY PRINCIPLE 30
Principle 1: Natural Environmental Systems 30
Principle 2: Human Use of and Dependence on Ecosystems 30
Principle 3: Human Influence on Natural Systems (Positive and Negative Impact) 31
Principle 4: Environmental Problems and Issues Related to Human Impact 32
Principle 5: Environmental management 32
Principle 6: Sustainable Development 34
4.0 GAP ASSESSMENT 34
4.1 THEME GAPS 34
4.2 PRINCIPLE GAPS 35
4.3 GAPS IN METHODS OF DELIVERY 36
5.0 RECOMMENDATION 37
5.1 GENERAL RECOMMENDATIONS 37
5.2 SPECIFIC RECOMMENDATIONS BY GRADE 39
8.0 ANNEXES ..... ERROR! BOOKMARK NOT DEFINED.
8.1 ANNEX A: COMPLETE SUMMARY OF SURVEY FIELD WORK ..... ERROR! BOOKMARK NOT DEFINED.

FIGURES

Figure 1: conservation concepts in the social studies curriculums 13
Figure 2: conservation concepts in the history studies curriculums 14
Figure 3: conservation concepts in the geography studies curriculums 15
Figure 4: conservation concepts in the science studies curriculums 16
Figure 5: conservation concepts in the biology studies curriculums 17
Figure 6: conservation concepts in the chemistry studies curriculums 18
Figure 7: conservation concepts in the physics studies curriculums 19
Figure 8: conservation concepts in the geology studies curriculums 21
Figure 9: conservation concepts in the Islamic education studies curriculums 22
Figure 10: conservation concepts in the English studies curriculums 23
Figure 11: conservation concepts in the Arabic studies curriculums 24
Figure 12: conservation concepts in the math studies curriculums 25
Figure 13: conservation concepts in the Art studies curriculums 26
Figure 14: conservation concepts in the vocational education studies curriculums 26
Figure 15: frequency concepts/ principles 28
Figure 16: total number of concepts/themes 34
Figure 17: methods of delivery of the themes in the curricula 36
Figure 18: use of the new integrated EE concepts and in enhancing learning 38

EXECUTIVE SUMMARY

Formal educational systems supported by suitable resources, teaching material and trained educators can play a great role in influencing young people's knowledge, attitudes and behavior in environmental issues. Within Jordan's national education system, environmental education is still considered a relatively new subject that has been addressed only modestly.

The objective of this study is to evaluate the concepts of water, energy and solid waste that exist in the curriculum and the manner in which they are tackled. To achieve that, the World of Letters team is mandated to map current textbooks based on the three themes of the study: water, energy and solid waste. In order to develop a holistic approach, the three themes are categorized under six main environmental education principles. These principles form the conceptual framework, based on which the mapping is conducted. Mapping was carried out by 14 educationalists. Each concept mapped was classified under the environmental education objectives of knowledge, attitude, skills, participation and ethics. A comprehensive survey of 104 school textbooks from grades 1-10 in fourteen subjects was conducted.

Results of the survey showed that environmental education concepts were vastly covered in all subjects of the study with a total of 1777 concepts. While there were more water than energy concepts in the curriculum, most focused on scientific facts and information and were often repeated. More important concepts that tackle issues of social, political and economic implications of environmental problems and crises, as well as sustainable development were vastly missing. Solid waste concepts were few, and lacked the depth required to promote real understanding. These concepts were often delivered as add-ons to topics. The sequential development of the water concepts was very good compared to that of energy and solid waste. While energy concepts were repetitive and did not follow a sequential flow, those of solid waste were few and scattered.

The greater, more sequential presence of water concepts was mainly due to the influence of the earlier WEPIA project. Despite the fact that the curriculum underwent several reforms and reviews following WEPIA, the curriculum division kept these concepts in the textbooks, recognizing their significance. Furthermore, while conducting the KAP survey of youth, it was clear that behaviors and attitudes of youth were independent of the amount of knowledge they acquired. Thus, any gap in information regarding solid waste and energy even if integrated in the curriculum would have little influence on children's behavior which is the focus of the project at hand. It is thus, recommended in this study that informative sessions be conducted with curriculum division members in order to influence the curriculum while carrying out more substantial projects which have real influence on attitudes and behaviors of youth.

Also, because of the style in which the Jordanian textbooks are presented, where there is greater emphasis on information and knowledge while very little space has been allocated to the synthesis and application of this information, the concepts remain superficially tackled. Furthermore, most activities and projects that promote skills and participation require support materials that include worksheets and background information that can only be presented in supplemental teacher's guide material. Currently, the teacher's guide is rarely used and does not serve this purpose.

It is thus recommended that support material be prepared for the different grade levels. These support materials range from educational kits for smaller grade levels to project ideas and implementation plans for higher grades. These projects would tackle important issues that were missing in the curriculum.

Furthermore, teachers as role models and represent the real agent of change to any attitude or behavior. In order to make these support materials effective and to ensure that teachers are using them efficiently,

comprehensive training programs needs to be developed for educators. These training programs should be intensive to ensure maximum success. Thus, it is recommended that a comprehensive training program with Queen Rania Teacher Training Academy be developed in which communities of practices are created and trained for long-term success.

The main key findings can be summarized in the following points:

- Environmental Education concepts are adequately, if not vastly, covered in the national textbooks. However, some concepts have greater emphasis than others. For example, water concepts are covered more extensively than energy concepts and solid waste concepts. This reflects the effects of the WEPIA projects and the concepts introduced to the curriculum as a result of it.

- Water concepts are covered in abundance despite the curriculum reform that occurred after the WEPIA project. This indicates a change in the attitude and approach of the curriculum division members after the completion of the earlier project. This may indicate that upon exposing curriculum division members to new ideas and concepts, and acquainting them with the importance of specific topics they will automatically integrate said concepts out of conviction.

- Based on the mapping survey, knowledge remains the dominant form in which environmental concepts are tackled, with skills as the second most common form of presentation. Participatory and ethical approaches are virtually absent from the current curriculum.

- The textbook mapping reflected the source of much of students' vast knowledge, but the theoretical nature of the curriculum did not involve the students directly in the environment. The lack of hands-on activities prevented a genuine, meaningful connection to environment. Furthermore, the methodology of the current textbook does not allow for the integration of these concepts in an interactive manner that promotes higher thinking skills and greater participation.

- When evaluating the scope and sequence chart, it was found that water themes followed a systematically-developed sequence of concepts through grade levels and subjects. However, while energy concepts are vastly covered, the concepts appear scattered and un-sequenced. At times energy concepts are loaded disproportionately into one grade (e.g., grade 10). Finally, the solid waste concepts were fewer and scattered without a real rationale to its development over grade levels.

- In all concepts surveyed there has been greater emphasis on demand management techniques and the role of individuals in conservation. However, these concepts are presented in a stand-alone, superficial fashion, delivered in the form of brute facts that often lack the requisite knowledge base or the depth of exploration and practical application needed to change values and attitudes.

- Concepts that are scientific in nature are more extensively covered with greater depth and understanding. Other concepts that emphasize a social, political or cultural dimension of the theme under study are minimally covered, typically in the form of pure knowledge, lacking the inquiry-based

learning that shapes attitudes and values. For example, natural ecosystems are covered most frequently in all textbooks, followed by demand management concepts. Concepts related to sustainability are the least-frequently covered.

1.0 INTRODUCTION

1.1 Project Background and Objectives

Environmental Education concepts were first introduced in the national curriculum in 1996 by the UNDP. A conceptual framework was prepared for all environmental concepts that needed to be tackled in the textbooks. This was the first attempt to introduce EE in the curriculum. In 2003, the Water Efficiency and Public Information for Action (WEPIA) program surveyed the national curriculum for water concepts. A water conceptual framework was prepared and textbooks in five subjects were mapped for water concepts. A total of 524 water concepts existed in the curriculum and about 100 concepts were inserted or revised in the textbooks, out of which 13 were digitized. The e-content material presented the concepts in an interactive manner and was produced on a CD. However, the CD was not distributed to the entire Kingdom due to the new Learning Management System that the Ministry of Education developed after the implementation of the project, rendering the CD incompatible with the new systems. The main focus of the project was to change values and attitudes towards water issues and to modify behaviors towards a more positive demand management approach. WEPIA project findings showed that concepts in the textbooks were in the form of knowledge and that reviewing already-taught concepts was more necessary than introducing new ones. As a result, 15 members of the curriculum division were trained on introducing new methodologies which promote inquiry learning and problem solving, the mastery of fundamental skills for gathering, organizing, interpreting, synthesizing, evaluating information, developing explanations, and communicating these understandings to others. A teacher's guide was produced to explain these new pedagogies to teachers. This was followed by the training of 90 teachers on the new concepts introduced in the curriculum.

In 2004, the Education Reform for Knowledge Economy Project (ERfKE) was launched. The project aimed at transforming education programs and practices for the knowledge economy. This meant that the Ministry carried out a comprehensive reform for the curriculum grades 1-12 with emphasis on classroom learning and an outcome-based curriculum. To fulfill this objective, curriculum division members were trained to use the newest strategies in introducing concepts which focus on exploration and critical thinking in young learners. All textbooks were changed.

Environmental concepts, similar to many other social concepts when introduced in the national curriculum, are often introduced within one or more discipline. EE concepts are not introduced as stand-alone subjects but rather require in-depth understanding gained from a variety of subjects. This process starts with the pure knowledge behind environmental issues tackled in the sciences, as well as with associated social problems, moving towards ethics and value-shaping, in which the main focus would be religion and civic education. Thus, a comprehensive mapping of environmental concepts must include all subjects. The intention of such a curriculum is to offer avenues that are creative, innovative, and avoid conventional fragmentation of environmental concepts.

The objectives of this research project as relevant to this survey and outlined by the Public Action for Water, Energy and Environment Project are to develop young people's knowledge concerning the scarcity and limitations of resources; encourage individual action that can contribute to conservation of these resources; and educate young people on how science and technology can provide alternatives to improve consumption patterns. To address these objectives this survey has focused on evaluating the formal curriculum. The survey enquiry can be summarized in three key components:

1) Exploration of existing formal systems and curricula at various levels and settings that contribute to or hinder learning processes. This includes the mapping of 104 textbooks in 14 subjects.

2) Evaluation of the presence of water, energy and solid waste concepts in the curriculum.
3) Identification of the form in which the three concepts are covered in the curriculum, whether it is through knowledge, skills, attitudes, practices, or environmental ethics.

1.2 Research Methodology

The mapping of concepts requires a specific methodology to ensure useful, accurate results. EE goals were formulated initially. Based on the formulated goals all other educational concepts were organized in reference to the outlined goals.

The established goal of Environmental Education is to make students knowledgeable and environmentally-aware citizens willing to act locally and collectively from an intrinsic motivation to defend and sustain the environment for future generations. The main analytical framework for mapping EE classifies the presentation of concepts into five main categories: perceptual awareness, knowledge, environmental skills, environmental participation, and environmental ethics. ***Perceptual awareness*** occurs when students appreciate and acquire sensitivity to the natural and human-made environment. ***Knowledge*** helps students acquire the foundation to understand and comprehend environmental systems. This is essential for taking environmental action. ***Environmental Skills*** help students develop proficiency in identifying, investigating, communicating, and being prepared to take action for the prevention and resolution environmental issues. ***Environmental Participation*** helps students apply the acquired perceptual awareness, knowledge, and environmental skills and ethics to take action for the prevention and resolution of environmental issues at various levels of society**.** ***Environmental ethics*** are used to develop universal ethics that students can act upon regardless of their culture and religion. Thus the student is motivated by their ethical values to practice positive environmental behavior for the general good for all living things, building solidarity with nature.
Beginning in the early years, attitudes and values can be shaped, while in later grades, young environmentalists can take action to effect change in their schools and local communities. Hence, increased participation is expected in later grades, whereas knowledge, awareness, and attitudinal statements are expected in younger grades.

Early in the project, technical specialists developed a conceptual framework for the main water, energy and solid waste concepts that need to be tackled in the national curriculum. The conceptual framework is the knowledge-base of these three main themes of the study. The conceptual framework consists of concepts that ideally should be introduced to textbooks in an approach that ensures the spiral development of the concept with the cognitive development of the student. Therefore, the mapping of EE in textbooks is integral to assuring that the age-specific comprehensive capacities of the students align with the environmental content present, as well as to develop in an organized, logical manner, building on concepts learned and adding dimensions as students get older.

Based on the recommendation of the Ministry of Education, Fourteen Subjects and ten grade levels were chosen by the survey team. A total of 104 books were surveyed in the subjects of Arabic, English, mathematics, social studies, history, geography, Islamic religion, vocational education, civic education, art, science, physics, chemistry, biology, and geology.

The project targeted grades 1-10 in both male and female schools. Mapping of the textbooks was carried out based on the five environmental education analytical categories (explained above) as well as the key themes of water, energy and solid waste. (Annex)

The follow-up process consisted of preparing scope and sequence charts implemented by teams of

educational consultants. In the scope and sequence charts all concepts that are found in the curriculum are listed on a three dimensional matrix. The 3-d matrix shows concepts covered in the textbook, the form in which it exists in these books and it presence in different grade levels and subjects. From this scope and sequence matrix, gaps and repetition of concepts are identified.

Recommendations are then cited based on the above matrix.

1.3 Conceptual Framework

A team of specialists from the project and from World of Letters prepared the main conceptual framework. The framework, which categorizes the essential EE concepts, is considered the knowledge base that is required for students regarding the themes identified.

Since water, energy and solid waste are concepts that are interrelated and interlinked, it was necessary that a framework be developed that would ensure a comprehensive link between different themes to make learning more holistic and contextualized. The main principles for the framework were adapted from materials produced by the California Environmental Protection Agency.

The principles begin by considering the earth as a virgin land with its systems in balance and the different components of these systems in equilibrium. The principles then progress to discuss the uses of human of this natural land and developing further to the effect of humans on natural systems and related environmental problems. Ultimately, the principle begins exploring the human role, critical to managing environmental problems and moving towards sustainability.

The principles and concepts of environmental education (based on materials from California's Environmental Protection Agency): (Annex)

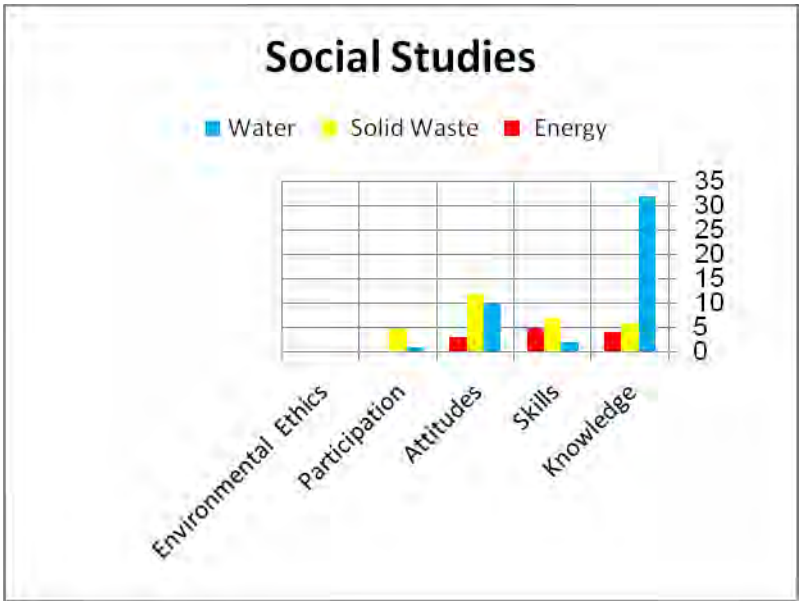
> *Principle 1:* Natural Environmental Systems.
> This principle includes systems of water and energy that are in harmony and equilibrium, and their sub-systems- exploring both the living and non-living elements-.
>
> *Principle 2*: Human Dependence and Influence on Natural Systems (uses)
> This principle focuses on the human uses of natural systems and their mutual interdependence.
>
> *Principle 3:* Human Influence on Natural Systems (Positive and Negative Impact)
> This principle highlights the positive and negative impacts of human use and exploration of natural systems.
>
> *Principle 4*: Environmental Problems and Issues Related to Human Impact
> This principle highlights the main environmental problems related to over-usage and over-consumption by human communities.
>
> *Principle 5:* Environmental Management of Resources
> This principle focuses on political, social, cultural, technological and environmental implications of water and energy problems and on management methods for solving these problems.
>
> *Principle 6:* Reaching towards Environmental Sustainability
> This principle deals with some of the bigger issues of sustainability, focusing on the role of societies and countries but beginning with the individual. This principle looks at energy, water and solid waste in a holistic approach and evaluates relevant interconnections.

2.0 **RESULTS OF TEXTBOOK MAPPING**

2.1 Social Studies (grades 1-10)

In grades 1-5 of the Ministry of Education social studies curriculums, the integrated approach is employed in delivering the curriculum whereby environmental principles are embedded about the three main concepts of the study, which are water, energy and solid waste. Grades 6 – 10 have a separate curriculum called National and Civic Education where the focus is primarily on legal issues pertaining to the Jordanian State, some ethical values, economics and human rights. The environmental principles are scattered in the curriculum whereby some attempts were made, although not consistently, to shed light on them.

Figure 1: conservation concepts in the social studies curriculums



Although there is a big occurrence of environmental principles in the civics program, with 87 concepts, more could be done. The books contained 45 water concepts (32 of which appeared as knowledge), 12 energy concepts (four of which appeared knowledge and five as skills), and 12 solid waste concepts (with four appearing as knowledge five appearing as skills). Again, and as has been shown in the history report, the majority of focus falls on issues related to water (on the knowledge level), whereas the themes of energy and solid waste are not focused upon in spite of their importance. Most concepts appear in the form of knowledge, while the skills components in the curricula are very weak. There was an attempt in the civics program to enhance students' participation, but it did not go beyond the theoretical level. Surprisingly, environmental ethics are completely absent from the civics program although it could easily be included.

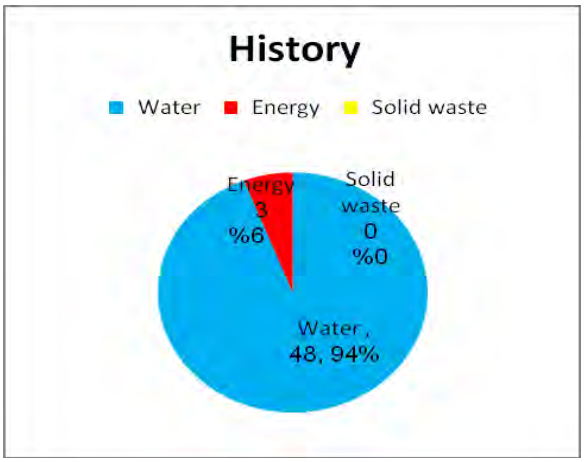
Recommendations:
Instead of theoretically learning about the institutions of the Jordanian government, the students should be encouraged to review public policies related to environmental issues in the country pertaining to water, energy and solid waste with the purpose of doing any of the following:

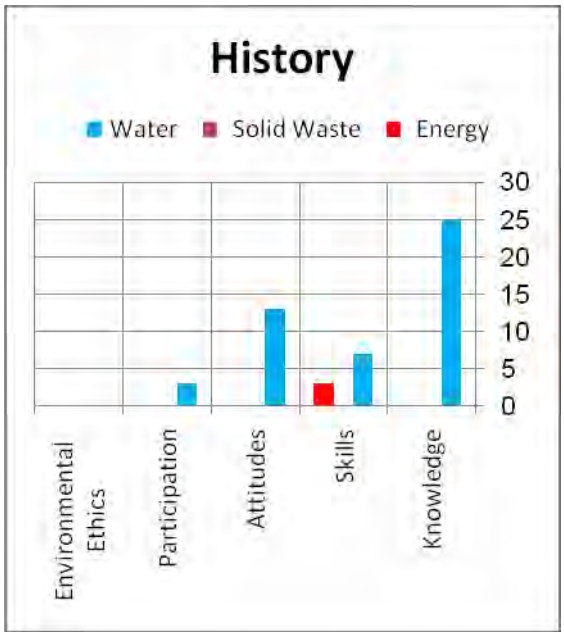
- Suggesting amendments to curriculum.
- Including in the curriculum the concept of "campaigning" that could include the dimensions of raising public awareness through campaigns, utilizing the radio stations, TV, school magazines, and extracurricular activities.

- Raising the awareness on crucial environmental issues coupled with the concept of effective and active citizenship. Recognizing local community problems, problem solving, decision-making, and suggesting alternative public policies and plans to deal with environmental problems should be constantly reinforced in the civics books.
- Training students to conduct campaigns that raise awareness and even organize local activities about saving energy resources, waste, recycling is an important component of a good extracurricular program in any school as well.

2.2 History (grades 1-10)

Figure 2: conservation concepts in the history studies curriculums





The subject of history presents itself as part of social studies from first through fifth grade. Upon reaching the sixth grade, history is introduced as a separate subject from social studies. The history curriculum covers a wide spectrum of historical epochs starting with ancient societies of Syria, Iraq, Egypt, India and China, the Moslem Empire. The subject also covers the revolutions of the world, including the Russian, French and American revolutions.

With regards to environmental concepts, the history curriculum contained 51 concepts, out of which 48 concepts were related to water (25 of which appeared as knowledge), 3 concepts regarded energy (all of which appeared as skills), while nothing was mentioned about solid waste.

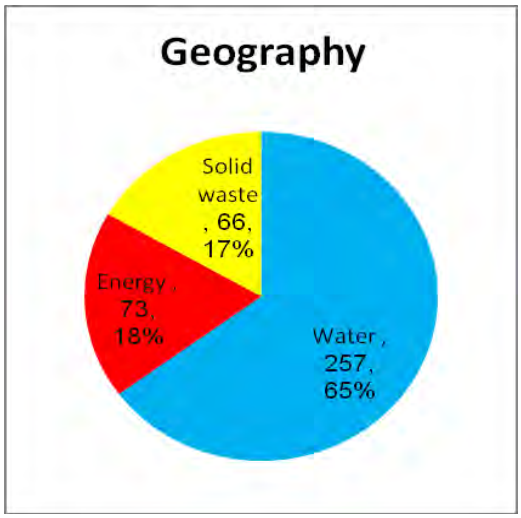
It was found that most environmental principles in the history curriculum are related to water issues, whereas solid waste issues are completely absent in from grades 1-10. While energy issues are present, reference to them is scant and is limited to a quick reinforcement of a basic reading of a chart. With regards to presentation of the concepts, a substantial amount of the principles are presented in the form of knowledge, which is considered to be the first level of knowledge attainment. Other skills such as analysis, synthesis, decision-making, and problem solving are completely absent.

Recommendations:
Many international curricula include case studies about environmental factors and how they affect the development or downfall of a civilization. For example, the history of the ancient Mesopotamian city of Ur is a classical example of how the solid waste problem polluted the waters of the River Tigris, thus prompting the inhabitants of the city to desert it and seek a new settlement elsewhere. Such a case study could easily be included in the grade seven curriculum that has a panoramic collection of ancient civilizations. The

environment and its resources could be easily integrated in the history curriculum. The same could also be said about issues related to energy and solid waste. As has been indicated in the example of Ur, the water was polluted because of the problem of inefficient ways of disposing wastes. The students' problem solving and decision making skills could be further reinforced by being asked to come up with solutions to environmental problems during different historical periods, which could be easily identified and thus provide solutions for.

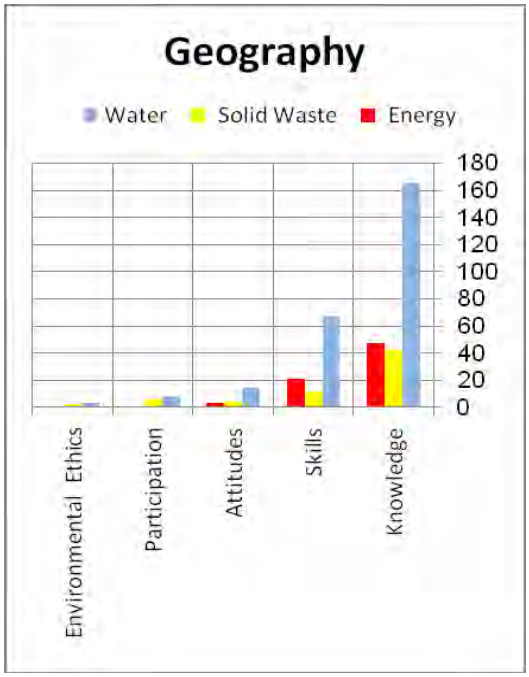
2.3 Geography (grades 6-10)

Figure 3: conservation concepts in the geography studies curriculums



Geography is presented as a separate subject from grades 6-10. The survey showed that geography contained the greatest number of environmental concepts out of all the subjects, with a total of 396 concepts. Water concepts were the most frequent by far, with 257 concepts; energy concepts numbered only 73, and solid waste concepts totaled 66.

Mapping results showed that more than 250 concepts were covered as knowledge, with most of the remaining presented as skills. The subject of geography could be considered a perfect venue for shaping attitudes and promoting participation. Unfortunately, the vast number of concepts introduced in a knowledge-base format results in that students receives vast amount of concepts without really contextualizing them.



The sequential development of water concepts was generally very good. Many vital concepts including water resources in Jordan, the Arab world, and neighboring countries were mentioned. Management techniques were introduced, including water harvesting and awareness methods.

However, there was discontinuity in the development of energy concepts. Moreover, the curriculum lacked emphasis on the energy sources in Jordan.

The topic of solid waste was only minimally and unsatisfactorily tackled. Concepts of waste collection and treatment were not introduced clearly. Types of waste and the three R's also remained unmentioned. These concepts need to be contextualized by presenting examples from Jordan and the Arab world, and more interactive lessons that highlight the role of individuals in their home, school and community are needed.

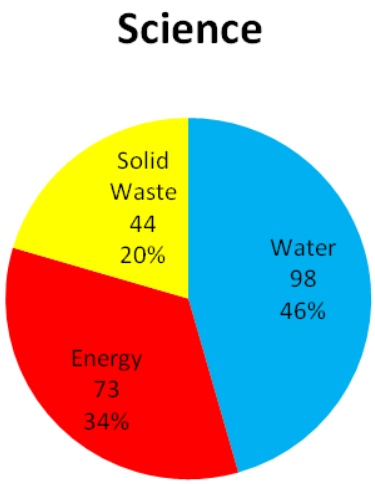
Recommendations:

Solid waste and energy concepts were not covered as adequately as water concepts. Generally, most concepts

were presented in the form of knowledge, which meant that students had to memorize large amounts of information. This made the subject undesirable and as a result students acquired negative attitudes towards the environment. The launch of social change campaigns in the local community to affect people's behaviors regarding the themes discussed is recommended. Additionally, it is recommended to feature social research projects that allow students to not only study people's environmental behaviors, but to also find the reasons behind said behaviors. These recommendations incorporate critical thinking, problem solving, debates, analyzing current issues, and advocating for change. This way, attitudes can be changed and positive ethical values can be instilled in students. Moreover, specific emphasis needs to be stressed regarding energy resources in Jordan.

2.4 Science (grades 1-8)

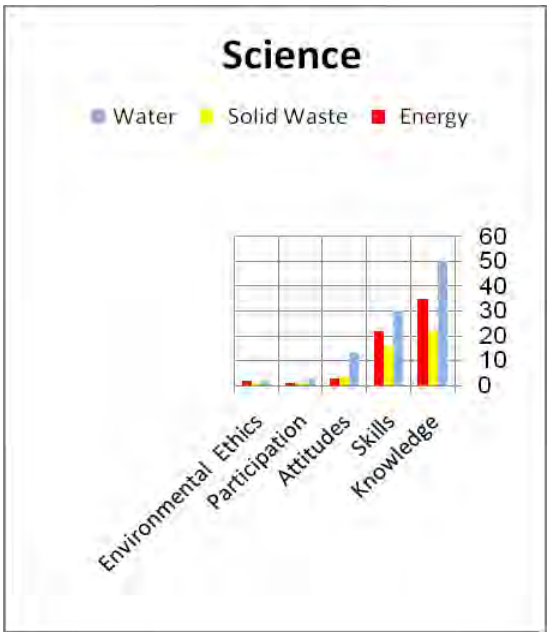
Figure 4: conservation concepts in the science studies curriculums



Sciences are taught from grades 1-8 as integrated subjects of geography, biology, and physics. The books surveyed from grades 1-8 included 409 concepts. Again, water concepts are covered in abundance with as many as 98 concepts. 73 concepts of energy and only 44 concepts of solid waste were also included.

These concepts were mainly presented in the form of knowledge and some as skills, and less often as attitudes; only occasionally did some concepts carry an ethics component.

The flow of concepts in the books was generally good. For example, water concepts were mentioned in all grades, and increased in complexity and depth as students grew older.



In general, water concepts were covered vastly in the earlier grades with great emphasis in grade 9. Alternative energy sources were referred to in grades 1 and 2 in the form of pictures that could be analyzed, but they were not contextualized to Jordan's energy sources. Energy concepts were covered vastly in grades five and six with emphasis on renewable sources of energy in Jordan, and further referred to in grade 8. Management and conservation of energy resources were not mentioned.

Solid waste concepts were limited in all the grade levels, and concepts were presented only in the form of facts and stating wrong and right behavior, lacking the depth and the practical application needed to change values and attitudes.

The concepts related to Jordan did not cover more than 20 % of the material surveyed. Concepts related to Jordan were mainly related to Jordan's water sources and the alternative sources of energy. There was some mention of the role that governmental organizations and non-

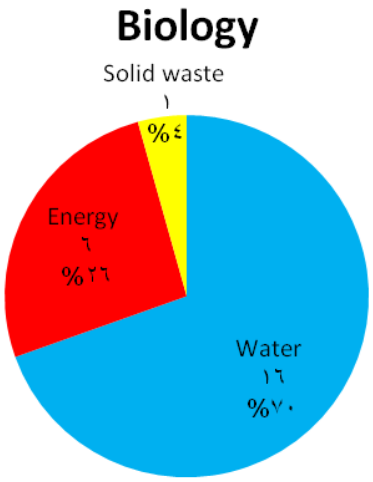
governmental organizations play in environmental conservation in Jordan.

Of concern is the level at which these concepts are tackled in different grades. Difficult environmental concepts were introduced in grades five and six and at times may have been introduced at a higher complexity level than what the students could comprehend. However, in grade eight, the concepts were very simple and seemed easier than those introduced in grades five and six.

Recommendations:
It is recommended that the rationale behind the distribution of environmental concepts in textbooks be evaluated and an environmental scope and sequence chart be prepared for the subject to ensure the spiral development of the concept with the cognitive development of the child.

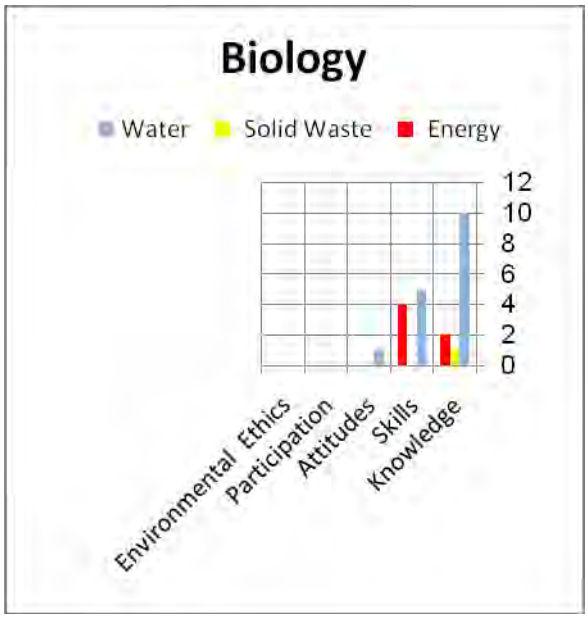
2.5 Biology (grades 9-10)

Figure 5: conservation concepts in the biology studies curriculums



The total number of concepts surveyed in the biology textbooks for grades 9 and 10 were 23. Water concepts were covered most with a total of 16 concepts, 62% of which were tackled as knowledge. There were 6 energy concepts, 33.3% of which were covered as knowledge while the remaining concepts were tackled as skills. Finally there was only one solid waste concept, covered as knowledge.

Concepts were included as complementary concepts to biological concepts. For example, the importance of water was discussed through the topic of cell activities, human health and food groups, and water balance in the human body. Some concepts were related to different ecosystems and biomes, such as fresh water ecosystems, humid areas, oceans and life, biological pollution as an environmental problem, and the importance of water in evolution, as well as geographical features, classification of some protozoa and their living in water, water pollution as a main cause of diseases, and the importance of using some ferns to purify and treat waste water. Also discussed were the biodiversity of Jordanian wild life and its impact on tourism, population growth and its impact on biodiversity and the negative impact on air and water pollution, the green house effect, as well as biogas and the economical importance of algae. Solid waste was mentioned through the topic of waste accumulation in food chains.

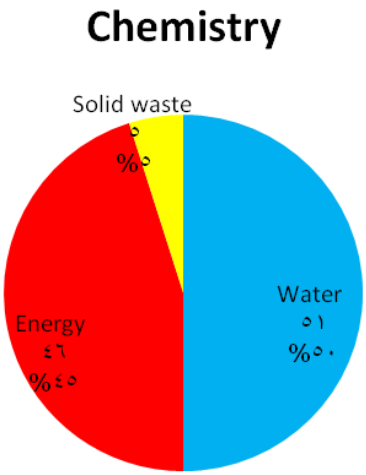


Many concepts in the matrix are not mentioned at all in textbooks. These concepts include: wet land concept, bioaccumulation and biomagnifications, and biological pollution.

Recommendations:
It is recommended to include the concepts mentioned above as well as modify some pictures in the book due to their lack of clarity in relation to the concepts they seek to explain. The introduction of further Environmental Education in the Biology textbooks to enhance environmentally positive behavior aims to insert practical projects that integrate human health with issues such as solid waste. Moreover, biology must contain concepts on the impact of different kinds of man-made disruptions and pollution on the delicately balanced environmental system, on biodiversity, and on human health in general. A strong ethical component should be added in which human beings are considered as a unit of the environment, and as a result share the responsibility of caring for it and remaining solidarity with nature.

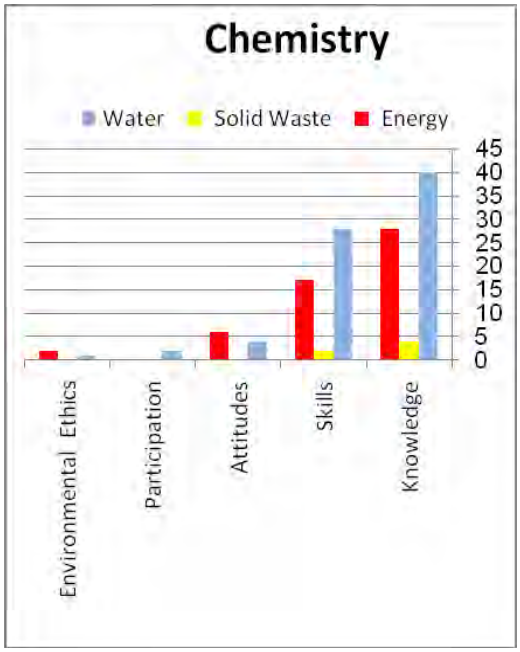
2.6 Chemistry (grades 9-10)

Figure 6: conservation concepts in the chemistry studies curriculums



A total of 102 concepts are covered in the chemistry books for grades 9-10. 51 concepts are covered as water concepts out of which 27.4 % are in the form of knowledge. 46 concepts are covered as energy concepts out of which 36.9% are in the form of knowledge. Finally, only 5 concepts are about solid waste. Most concepts are covered as knowledge and skills with some as attitude, with minimal emphasis on participation and ethics.

The environmental concepts present in the chemistry curriculum did not flow smoothly, with poor sequencing, rendering the material difficult for holistic understanding. Moreover, many concepts were redundant within certain grades as well as across grades. The curriculum also lacked projects and hands-on activities to help instill said concepts, as well as contextualize them through real-life activities.



In grade 9 most of the concepts focus on physical and chemical properties of water and compare drinking and bottled water. Water quality as identified by Jordanian standards is also mentioned. Explanations of water pollution and conservation methods, as well as water treatment appear.

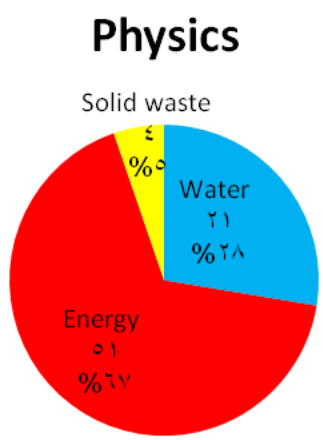
In grade 10 there is a greater focus on energy resources. Energy topics include atomic energy, chemical reactions such as burning coal, and the production of CO_2. Emphasis is also placed on fossil fuels as the main source of energy, and the diminishing sources. The 10th grade books also cover natural gas and energy transformation. Only 5% of the surveyed environmental concepts contextualize them, relating them to Jordan. Examples are given such as the bio-gas project which works on using waste as a source of energy and fertilizers. From a global environmental perspective, the book discusses acid rain and global warming.

There was a lot of repetition of concepts: the physical and chemical properties of water were mentioned 10 times, accounting for approximately 10% of the102 concepts, and energy transformation was mentioned 34 times.

Recommendations:
Project-based and inquiry learning forms the basis for changing attitudes and behaviors. It is recommended that projects be designed where students are trained to research and explore environmental issues, critically analyze them, and come up with solutions. Innovation and creation should be encouraged by giving enough space for experimentation. It is also recommended that projects be designed for each grade level, tackling the themes of the survey.

2.7 Physics (grades 9-10)

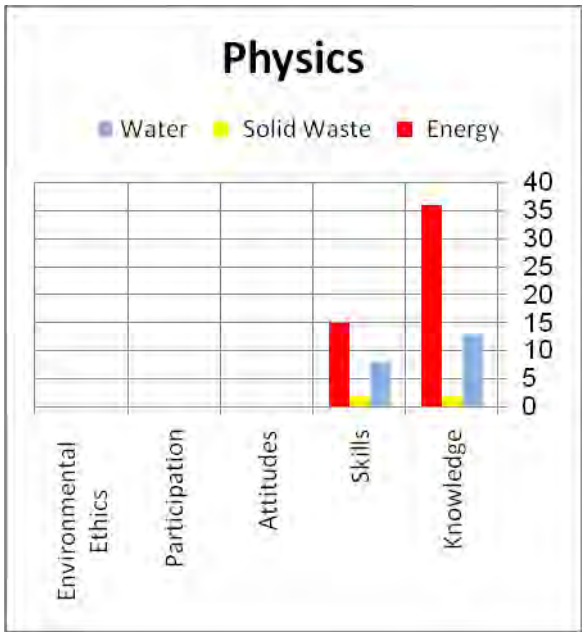
Figure 7: conservation concepts in the physics studies curriculums



A total of 76 concepts were mapped in the textbooks for grades 9 and 10. Because of the nature of the subject there were 51 energy concepts, 21 water concepts and 4 solid waste concepts.

The concepts were dealt with as knowledge and skills and none had an attitudinal or ethical component. The concepts sequencing was appropriate to grade levels. Some concepts were repeated between grades in a manner that positively reinforced the concepts. Concepts related to Jordan constituted only 11% of the total, focusing mainly on the conservation of energy and alternative energy sources.

Energy concepts emphasized mainly sources of energy, uses, and their impact on the environment. Additionally, some recommendations and solutions were proposed to solve energy problems. Regarding water, the emphasis was mainly on the physical properties of water, water ecosystems and uses. The negative and positive impact of humans on nature and solutions to some problems were also presented.



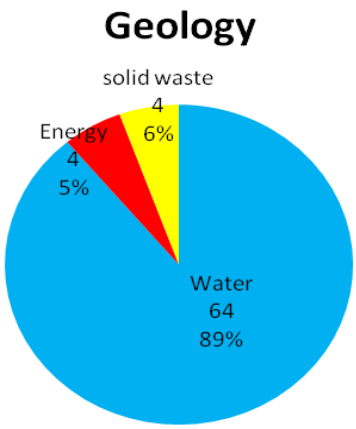
The lessons always started with an inquiry question, then an explanation of the concepts, which was followed by application through experimentation, and further investigations through activities or new inquiry questions. In some cases a concept started in grade 9 and then was expanded in grade 10. All the concepts that appeared in the books were included in the matrix.

Recommendations:
It is recommended that concepts be introduced that focus on hands-on activities with direct application of mathematical and physical laws to the creation of

modern-day green technology. This not only stimulates creative thinking, critical thinking, innovation, and a deeper understanding of concepts, but could also lead to environmental conservation and sustainability.

2.8 Geology (grades 9-10)

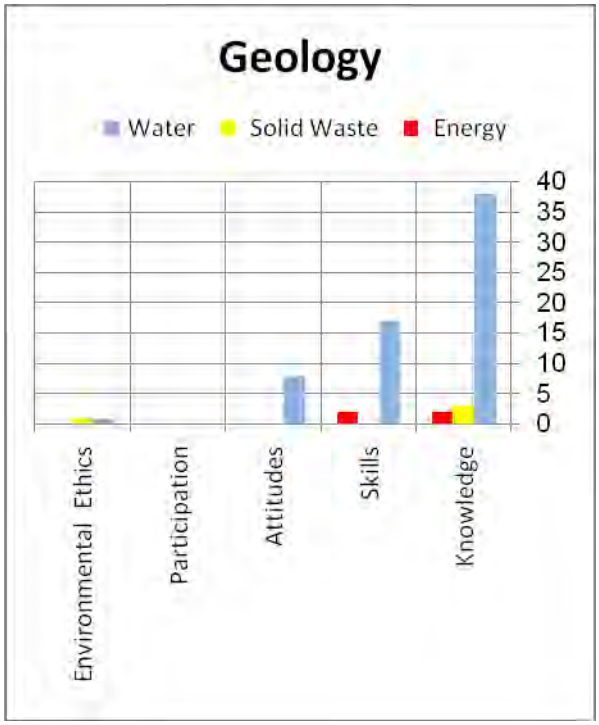
Figure 8: conservation concepts in the geology studies curriculums



The subject of geology appears exclusively in grades 9 and 10. The total number of water, energy and solid waste concepts covered in grades 9-10 is 72. 89% (64 concepts) of these are water concepts and 5% are energy-related while the remaining 6% are solid waste concepts. Almost 60% of these concepts are covered as knowledge, 28% as skills, 11% as attitudes and 1% as ethics.

Most of the water concepts were introduced in grade 9 with very few in grade 10. The concepts were introduced mainly as knowledge and skills with some attitude. The saturated knowledge-based concepts meant that students developed a hatred for environmental issues due to the large number of concepts they are expected to learn. About 5% of the concepts were related to real life examples within the Jordanian context.

It is recommended that in grade 10 further enhancement of Principal 5 of the conceptual framework, *Environmental Management of Resources* should occur. Other related concepts such as climate change, sustainable development, zero waste, and carbon footprints could be introduced as well. These concepts instigate critical thinking and problem-solving skills needed to change attitudes and take action.



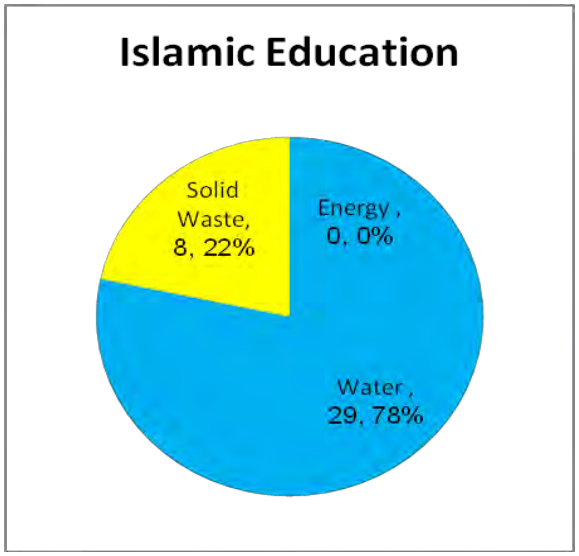
Recommendations:

It is also recommended that more fieldtrips be offered for grade 9 where students may participate interactively with concepts learned. Furthermore, this direct involvement in theoretical material makes the theory behind concept a reality, and thus renders it significant to students' lives, and environmental issues become more interesting and compelling. Field visits also ensure that youth learn more about and participate in their local community.

Interactive software for the three themes of water, energy and solid waste can be introduced. For example, groundwater flow modeling, at present, remains purely theoretical, with students unable to visualize the process. To change this, interactive software that makes such abstract concepts comprehensible could be developed, allowing students to participate in simulations of large-scale environmental processes and issues.

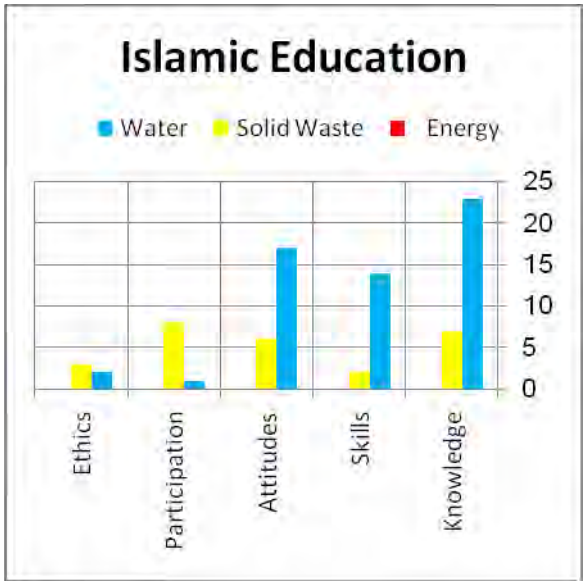
2.9 Islamic Education

Figure 9: conservation concepts in the Islamic education studies curriculums



The Islamic education curriculum contains 37 environmental concepts, with 29 concepts related to water and only 8 concepts related to solid waste. There was no mention of energy in any of the grades. Concepts related to water appeared 23 times in the form of knowledge, 14 times as skills, 17 times as attitudes, once as participation, and only twice as environmental ethics. Water was mentioned in Quranic verses, or in the instruction for ablution and general cleanliness and purity. It also appeared when speaking of the Creator's ability to control nature such as rain fall, praying for rain, and the importance of rain for the flourishing God's creations. Due to the nature of the subject, topics were not arranged according to environmental content, but were rather distributed as needed, with top organizational priority going to religious topics.

The 8 Solid waste concepts that appeared in the books were mentioned 7 times as knowledge, twice as skills, 6 times a **S**attitudes, 8 times as participation and 3 times as environmental ethics. These concepts followed no sequential development. Solid waste concepts mentioned spoke of not using solid waste to disturb neighbors, removing harmful objects from roads. The books also speak of disposing of trash in a manner that maintains general cleanliness, social health, and the beauty of the area, and avoids air and water pollution. The concepts stress caring for trees and keeping surrounding areas as clean as possible.



All the above-mentioned aspects are directly related to the daily life and practices of a Muslim student. This adds a religious aspect to the motivation behind the environmentally friendly actions. The concepts in the matrix that remained unmentioned in the Islamic education books are those related to energy, sustainable management, and scientific information about the water, energy and solid waste. Much focus was placed on ethical issues, the use of water, and some water and waste management issues such as water conservation and avoiding its pollution. All concepts appearing in the books were present in the matrix. Furthermore, many concepts were repeated, such as using water for ablution and general cleanliness.

Recommendations:

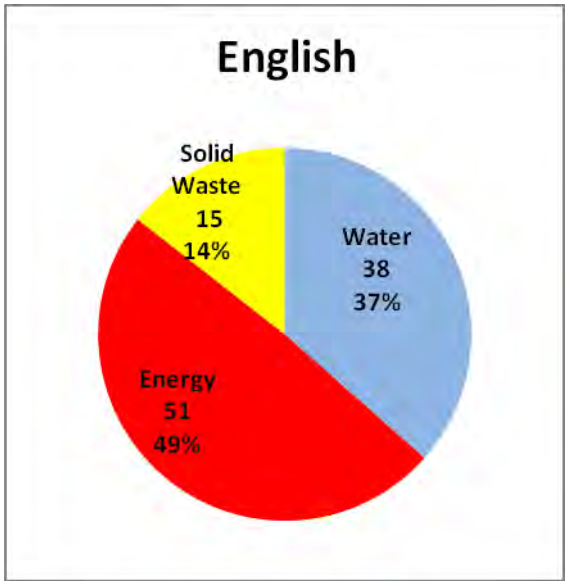
Islamic education contributes to the formation of human values and ethics, especially since religious morals in Arab states have a very strong impact on how an individual deals with his/her surroundings. Thus, adding concepts of varied environmental ethics will have a positive effect on society once it is rooted in the individual. Thus it is recommended that Islamic education contain a wealth of concepts on environmental ethics, relating positive environmental behaviors to Islamic values.

Students could participate in community awareness campaigns by designing and distributing brochures and flyers on environmental issues from an Islamic perspective. Students could also make field visits to mosques in which gray water is used or in which positive waste management methods are used such as recycling, reuse, and redistribution of unwanted items to the poor. Students could then help apply these environmentally friendly behaviors to other mosques in the community. The topic of energy needs to be highlighted further, with particular focus on the concepts of energy conservation and resource protection. Also, the institution of energy proctors who are responsible for monitoring energy use at home and school will instill a sense of responsibility in students.

Moreover, it is recommended to add concepts about humans as part of creation, and how God made human beings custodians of the earth, but mankind misused this authority and began to deplete the resources without any consideration. Therefore, humans must realize that God owns all that is on earth, and that humans are only one of God's creations, and thus humans must sustain and protect the earth for generations to come.

2.10 English

Figure 10: conservation concepts in the English studies curriculums



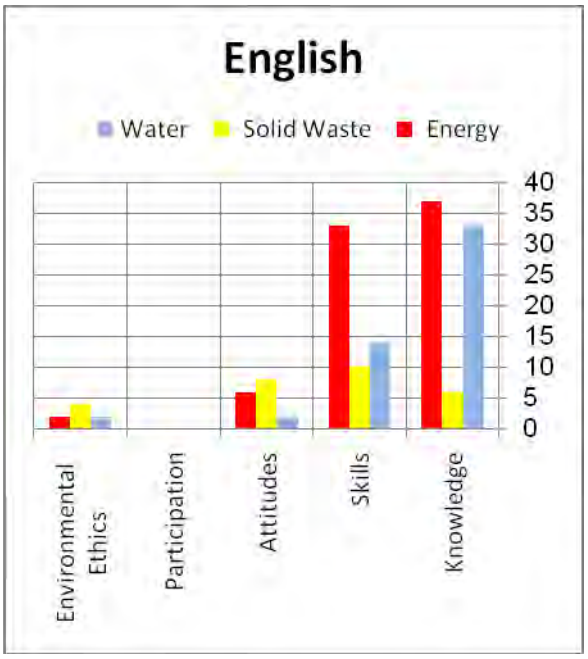
The national English curriculum contained 157 appearances of 104 environmental concepts surrounding the three themes of water (51 appearances of 38 concepts), energy (7 appearances of 51 concepts), and solid waste (28 appearances of 15 concepts). Environmental concepts primarily appeared in the form of knowledge, with the presence of environmental articles and pieces. Grammatical and compositional exercises contained the bulk of the remaining appearances. Attitudes were also present much more rarely. Books included few environmental ethics statements and contained no participatory forms of EE.

Unlike in science courses, the progression of environmental concepts is not the main priority of the subject. Thus environmental concepts appeared quite randomly overall, though some specific chapters focused on themes like "alternative energy."

English study begins in the first grade but it is not until the third grade that any environmental concepts appear in the curricula. Solid waste, littering, and even the historical use of water in Petra are mentioned in the third and fourth grades, but overall the first four years of public English schooling contain virtually no environmental concepts.

The fifth grade features many environmental concepts related to water and energy. The seventh and eighth grades contain a fair amount of environmental concepts, including global warming, pollution, water, environmental action, and the role of individuals and governments. Concepts proliferate in the ninth and tenth grade curricula, focusing on energy and water but not solid waste. Students continue to learn how lifestyle changes can benefit the environment. The tenth grade also focuses on fossil fuels and alternatives. Water topics include cleanliness, scarcity, overconsumption, and necessity, along with natural disasters. Solid waste is considered only in the ninth grade, which mentions recycling and reuse.

The mixture of local and global environmental issues in the curriculum provides a holistic understanding of environmental problems, but a greater focus on water issues in Jordan is needed. The English curriculum did not cover ways of reducing water consumption from an individual level. Throughout, many concepts were needlessly repeated, while others were left out entirely (such non-air forms of pollution).

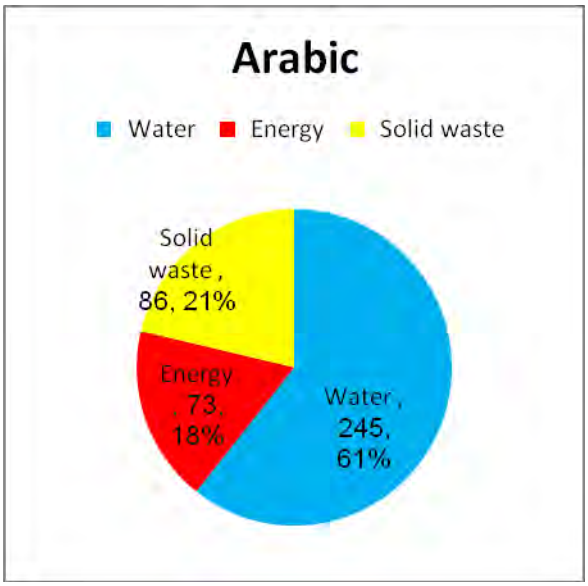


In most cases when talking about reducing pollution using electric cars is suggested, leaving the impression that electricity is an environmentally friendly form of energy. The English books generally suggest both individual ways to save the environment as well as the need for government action. However, some of the suggested individual behaviors are not very practical in Jordan, such as riding bikes and recycling, potentially discouraging environmental involvement since suggested methods of participation prove unrealistic.

Recommendations:
Curriculum revision should incorporate a more logical flow and development of environmental concepts, beginning with intrinsic attitudinal, practical, and environmental ethics statements and activities. An increase in water related environmental concepts would be helpful, as would a better discussion of realistic possibilities for student participation in environmentally positive behaviors relevant to Jordan.

2.11 Arabic

Figure 11: conservation concepts in the Arabic studies curriculums

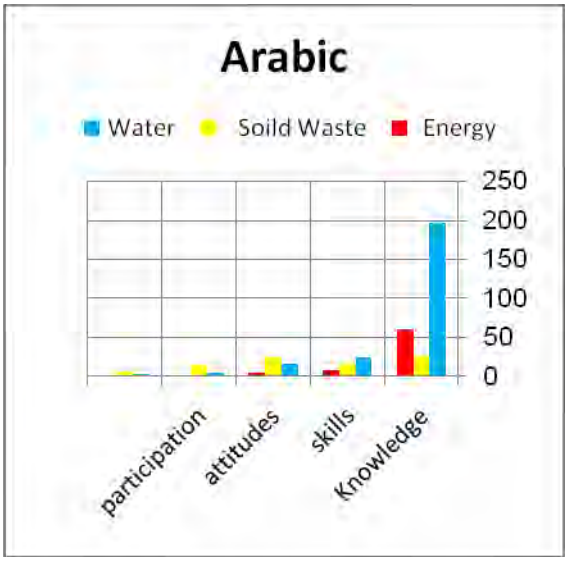


A total of 404 environmental concepts appeared in the Arabic curriculum from grades 1-10, with 245 water concepts, 73 energy concepts, and 86 solid waste concepts. The majority of concepts appeared in the form of knowledge, with many appearing as skills, multiple appearing as attitudes (especially solid waste concepts), some appearing as participation, and very few appearing in the form of environmental ethics.

The concepts appeared randomly, without any particular progression, the goal of the textbooks being primarily linguistic rather than environmental. Only once did an Arabic lesson seem to have an environmental objective in addition to the linguistic objective. This lesson, appearing in the 6th grade curriculum, covers what blessing water is. Nevertheless, there is generally no gradation in environmental concepts.

Presentation of water concepts included pictures of the King Talal Dam, Aqaba, Ma'an Hot Springs, a kid washing a car, etc. The textbooks also incorporated Quranic verses referring to water, and Hadiths (Prophetic sayings) that encourage the rationing of water consumption. Solid waste concepts were contextualized primarily in relation to the subject of cleanliness. The rationing of energy consumption also appeared as a way of contextualizing energy concepts.

There were no concepts included in the textbooks that were not classified in the matrix due to the comprehensive nature of the matrix itself. Actually, many concepts included in the matrix were completely absent from the textbooks, while other concepts were repeated throughout the textbooks, reinforcing the benefits of positive environmental behavior and the detriments of negative behaviors in relation to the three sets of concepts.

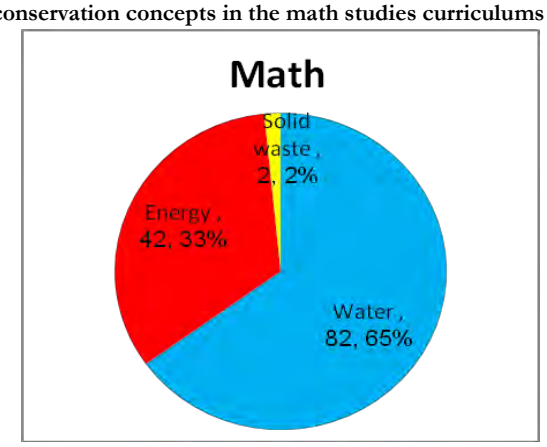


Recommendations:
The curriculum should deal with the concepts of personal health in connection to water, energy, and solid waste, electrical safety at school and at home, environmentally positive behaviors, water shortages, the effects of population growth, and political issues with water (specifically stating the relations between Jordan and Israel with regards to water and solid waste).

It is also recommended that the concepts presented in the textbooks appear in conformity with the age level of the students. Moreover, all subjects must take into consideration the sequential development of concepts, with concepts building on each other from one grade to the next, ensuring that previous grades provide sufficient information for the further development of concepts in subsequent grades.

2.12 Mathematics (grades 1-10)

Figure 12: conservation concepts in the math studies curriculums

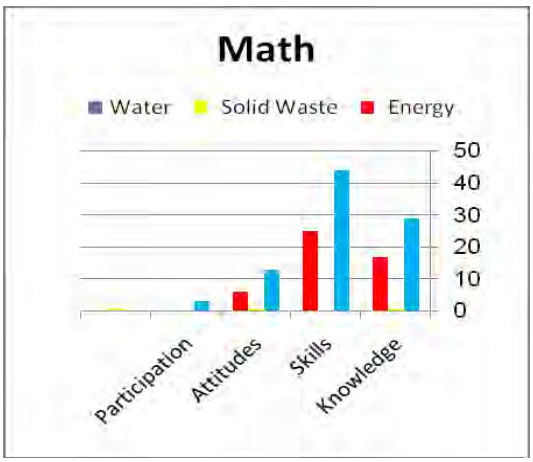


The total number of water, energy and solid waste concepts covered in mathematics textbooks from grades 1-10 was 128. There were as many as 82 concepts of water, 42 concepts of energy, but only 2 of solid waste. The concepts present in mathematics are mostly in the form of skills since they are used as examples for reinforcing mathematical concepts. There was no sequencing of environmental concepts, but they were rather used as examples to solve problems in real life situations.

As for concepts related to Jordan, there were very few examples mentioning the sources of water in Jordan. Examples were mainly related to real life issues like the calculation of water or electricity bills, the volume of storage tanks, and water conservation issues.

Recommendations:
It is recommended that comprehensive, theme-based lessons be prepared for the subject. For example, as mathematical concepts are introduced they could be contextualized under the themes of water, energy, and solid waste. This means that rather than having the units refer to an abstract mathematical concept, it could alternatively refer to real-life contextualized concepts.

This approach would be difficult to apply since it would require amending the methodology for the entire textbook. Another approach would be to introduce supplemental resources to support the textbooks, contextualizing the mathematical concepts through environmental, practical, real-life themes.

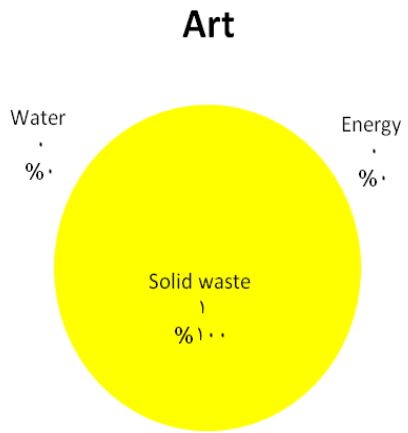


2.13 Art (grades 8-10)

Figure 13: conservation concepts in the Art studies curriculums

The subject of art contains textbooks starting from grade 8. The survey of the arts books from grades 8-10 found that there were no concepts covering water and energy and that there was only one concept of solid waste, tackling the concept of recycling waste into art. The concept was introduced as information that was not related to real applicable examples.

Recommendations:
A review of the textbooks is recommended to engage youth in art activities while focusing on the themes of the study and contextualizing it to Jordan.

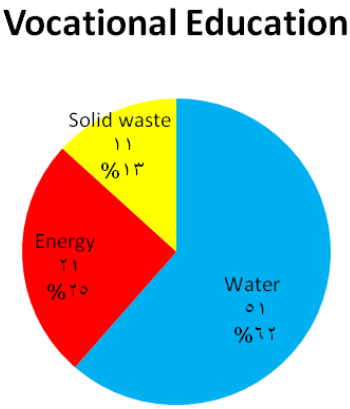


2.14 Vocational Education (grades 1-10)

Figure 14: conservation concepts in the vocational education studies curriculums

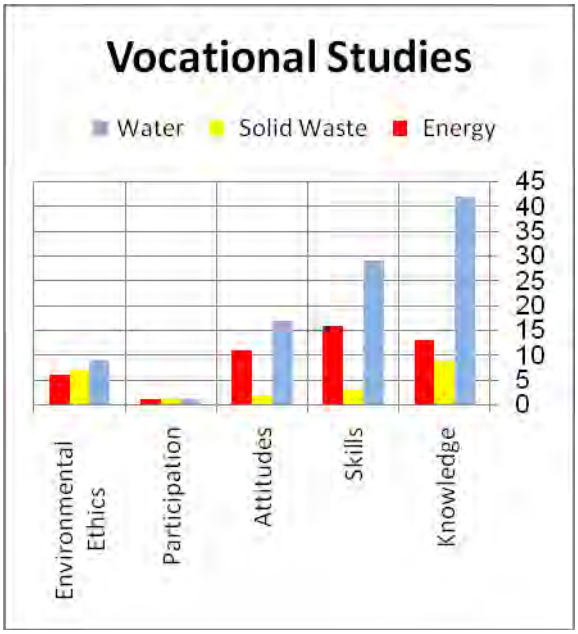
Vocational education textbooks are a good venue to introduce the practical application part of environmental education. This can include simple vocational work at school and home to increase efficiency in water, energy and solid waste.

The total number of concepts that appeared in the vocational books for grades 1-10 was 83. Concerning water there were 51 concepts with 82% covered as pure knowledge; concerning energy, 21 concepts were covered with 62% covered as knowledge; concerning solid waste,11 concepts were covered as solid waste with 82% as knowledge.



Concepts were tackled in the form of knowledge, skills and attitude with emphasis on environmental ethics. However, participation-based teaching was minimal.

The same concepts were repeated many times, and in many cases the same concept was introduced in the form of knowledge, skills, and behavioral actions that children should and should not do. There is a lack of real experimentation and thus children do not learn by conducting hands-on activities. Youth unconvinced by the theoretically taught implications of negative environmental behavior may do very little to actually apply what they learn at home.



Examples of repeated concepts are uses of water for personal hygiene, simple electrical work at home, uses of electricity devices at home, and safety measures.

There were several vital concepts missing from the textbooks and that should be included in the form of projects to enhance environmental learning, such as water and energy audits at school and at home. Pricing of water and energy bills would also be valuable for learning more about current domestic consumption rates. This would also include the role of government in subsidizing water and energy bills. These concepts could be introduced as projects that can be applicable at home and in their local community. For example, students could conduct water audits at home or at school, identify problem areas, come up with viable solutions, and subsequently apply them. Regarding energy, there should be more emphasis on the sources of energy in Jordan and the lack of resources. Although there is some mention of sources of alternative energy, it is not contextualized for Jordan. It is also recommended that real solar energy projects be implemented at schools to make them more energy efficient.

In solid waste, concepts are minimally tackled. It is recommended that concepts such as types of waste, RRR, waste collection, waste management, and waste disposal be introduced. Other concepts such as waste reduction and zero waste are vital in introducing the sustainability component. Solid waste concepts need to be introduced as projects that can be implemented locally and that can shape students' values and attitudes.

In summary, vocational education is a good venue to introduce practical environmental projects that promote sustainability and enhance positive environmental behaviors, including projects that can be implemented at home.

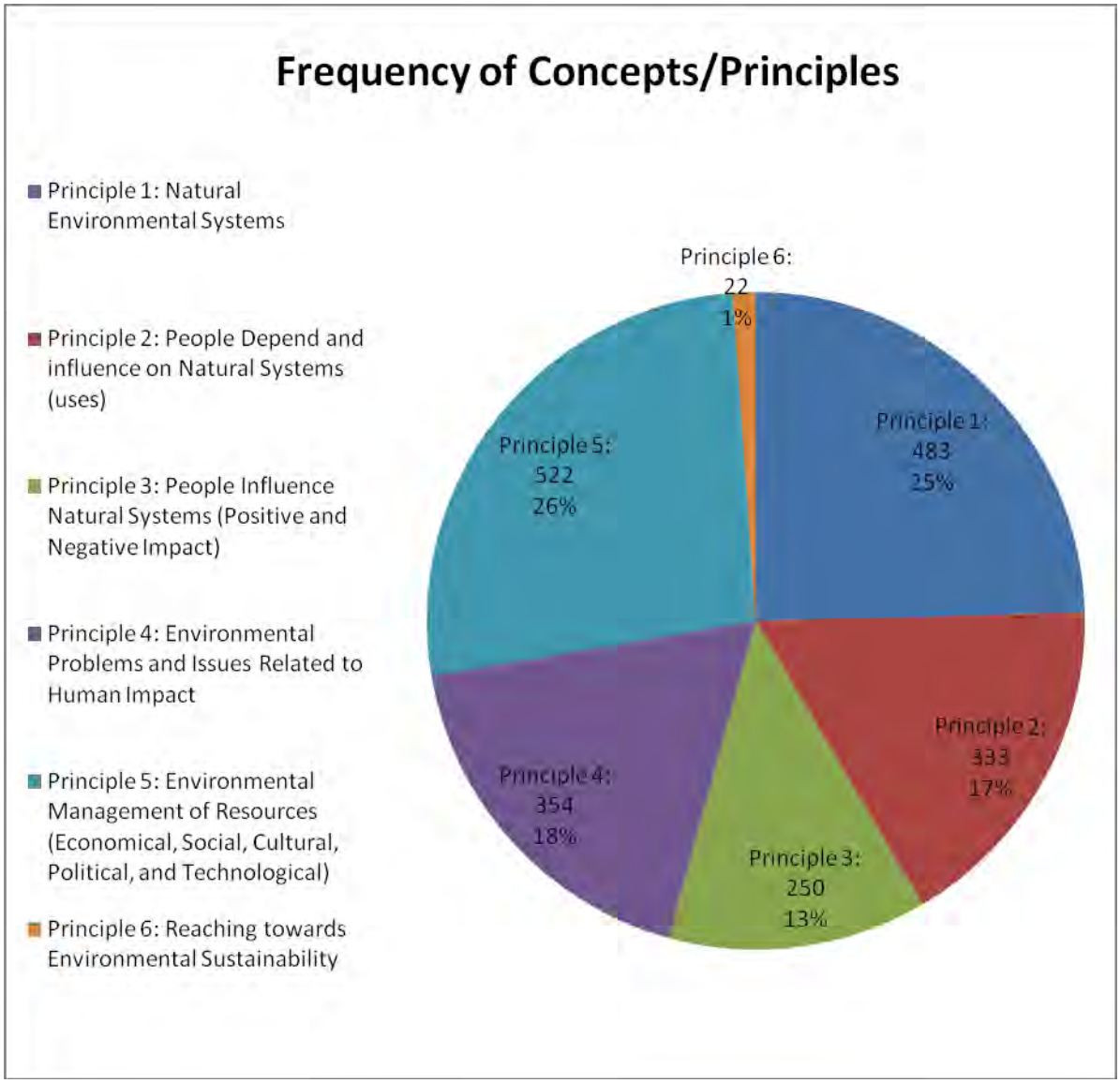
The vocational textbooks lack the practical component that contextualizes concepts to real life situations despite the vocational, practical nature of the subject. The methodology of the current textbook does not allow for the integration of these concepts in an interactive manner that promotes higher thinking skills and participation.

Recommendations:
Several projects should be introduced for the different grade levels. These projects would promote positive behavior and sustainability for future generations, and would instill the individual responsibility of "caring for nature" in schoolchildren.

3.0 **SCOPE AND SEQUENCE CHART RESULTS**

3.1 Theme-based Results

Figure 15: frequency concepts/ principles



3.2 General Results

In general there were a total of 1777 but when preparing scope and sequence charts a total of 1964 were present. The reason for this variation in number is that concepts on water, energy and solid waste were coded under more than one principle which meant repletion of concepts. The six principles can be divided into three categories. Category 1 containing principles 1 and 2 focusing on natural systems and their uses; category 2 contains principles 3 and 4 cover human influence and impact on natural systems; categories 3 contains principles 5 and 6 focus on management of resources and their sustainability.

The number of concepts in category 1 is vast reaching almost 816 concepts and appears mainly in the form of knowledge. After further analysis, it was clear that repetitions existed when tackling the water concepts, such as in the uses of water in different sectors and water ecosystems, but overall this category had the fewest gaps in the discussion of concepts.

Category 2 mainly covers human influence and impact on these systems, covering 604 concepts. Although the concepts again are vast, the emphasis of these concepts is on issues that are irrelevant to the local Jordanian context. Principle 3, although adequately covered, was greatly fragmented in treatment, and there were some apparent gaps in solid waste concepts. Solid waste is introduced under this principle and it was apparent that the presentation of concepts did not follow a sequential rationale. Principle 4 was adequately covered, and there was adequate if not excessive coverage of global water, energy and solid waste problems, but only a limited description of local Jordanian problems such as water shortages and quality, solid waste and management issues, and nuclear waste. Very few gaps existed in the presentation of this concept.

Category 3 focuses on management of resources and sustainability. Both of these categories focus on human action in correcting and avoiding environmental degradation and damage and living sustainably. Principle 5 has been covered vastly, with as many as 522 concepts. This principle focuses on political, social, and environmental implications of water and energy problems and on management methods for solving these problems. Although there are many concepts that are not distributed equally, so while some concepts are vastly covered (such as the importance of water conservation and awareness strategies), others (such as laws and regulations and distribution systems) are barely mentioned at all. The same applies to the topic of energy. While mention of energy conservation methods is vast, the curricula lack concepts on the economics of energy and market supply and demand. The problem with this lack of uniform distribution is that whilst people know what they need to do to conserve, they are unaware of the larger political and environmental implications of their actions. So, students do not connect their actions to more holistic environmental, political, and economic implications or relate them to the country's strategy on these issues.

Principle 6 included many of the new concepts, which focus on the holistic approach toward the environment, looking at the inter-linkages of water, energy, and solid waste. However, only 22 concepts exist and there are many gaps in these concepts. This principle is what shapes attitudes and values as people see themselves as part of a collective movement to conserve nature. With the vast previous knowledge of scientific concepts, the impact of people, and attempts to rectify the problem, this principle comes as an ethical check for humans to act collectively for change.

3.3 Results by Principle

Principle 1: Natural Environmental Systems

A total of 483 concepts are included within this principle, covering the themes of water and energy. Solid waste is not included under this principal since it is not part of the natural ecosystem.

The topic of water includes discussion of the physical, chemical, and biological properties of water; the properties of water in nature; the geochemical cycles in nature, including the water cycle; aquatic ecosystems; and saltwater, freshwater, and groundwater aquatic ecosystems. These various water-related concepts are covered at all grade levels equally with much repetition, especially the water cycle concept which is repeated 68 times in the various textbooks. Other geochemical cycles were not mentioned at all.

Aquatic ecosystems are also covered through all grade levels, starting in a few subjects but eventually they are presented through a wider range of subjects, particularly in the sciences, geography and the languages. Concepts related to water ecosystems and marine ecosystems appear in all grade levels to some degree, but are most prominent in grade 9. Freshwater is discussed in grades 3, 6, 7, 8, and 9, appearing in language courses in lower grades and in the sciences in higher grades. The freshwater and marine ecosystem concepts were copious with the former mentioned 87 times and the latter mentioned 36 times in the various textbooks. Greater emphasis of concepts occurred in grade 9.

Energy concepts include definitions, types, sources and energy transformation. There are very few energy concepts introduced in the early grades but discussion increased dramatically from grade 5 onwards, with the greatest emphasis being in grade 10 sciences.

Renewable and nonrenewable energy resources were minimally mentioned in grades 1 and 2 and were neglected entirely in grades 3 and 4. The concepts were later introduced in abundance in sciences, languages, and math. The topic of energy transformations started to appear in grades 1 and 2 in the form of simple sentence exercises in the Arabic language curriculum, reappearing in grades 8-10 in sciences, English, and geography.

It was clear that there is an evident absence of energy concepts in early grades and saturation in grades 9 and 10. There is a gap in between the early mention of the concepts and the extensive explanations presented in the later grades. This affects the students' knowledge. This was evident from the earlier survey in which most students grades 1-8 were not able to identify fossil fuel as the main source of energy for Jordan.

It is recommended that a greater emphasis be given to energy concepts in the earlier grades. The approach to introducing these concepts should be child-friendly, emphasizing play while learning. Audiovisuals, games, booklets, and experiments could be introduced in an interactive package for each student. The packages would include the missing concepts of energy and water, contextualized to their local school environment.

Principle 2: Human Use of and Dependence on Ecosystems

Here again solid waste is still not included, since it is less relevant to human needs. Water topics cited under this principle include water uses and types of use by percentage, water resources in Jordan, shared water sources, and water and health.

A total of 333 of these concepts were present in the mapped textbooks.
The various uses of water constituted the most frequently covered topic at all grade levels, covered as many as 136 times in textbooks. Percentage of water use in various sectors (industrial, commercial, and domestic) only appeared in grade 3. This result was reflected in the knowledge of students and verified during the earlier field survey. Water resources in Jordan were discussed at all grade levels, but appeared most prominently in grade 9 in sciences and geography.

Important concepts that were covered only minimally include shared water resources with neighboring countries, which appeared only after grade 6 in geography.

With regards to energy concepts, energy production was mentioned mainly in grade 10 in science and English with a few concepts found in the math curriculum. Energy uses were mentioned at all grade levels but appeared most in grade 10 in science, English, and math.

Discussion of the use of energy sources in various sectors (industrial, commercial, domestic) by percentage was very limited as well. Water and energy inter-linkages were only mentioned in grade 10 English.

There is an evident absence of knowledge related to Jordan's highest consumers of water and energy and thus the role of the individual in effecting change. There is also an absence of discussion of Jordan's shared water resources and of the inter-linkages between water and energy. It is recommended that for grades 5-7 research-based support materials produced, in which youth can explore the above concepts and be able to share their findings with officials and decision makers.

Principle 3: Human Influence on Natural Systems (Positive and Negative Impact)

There were a total of 250 concepts covered under this principle. The concepts under this principle for water, energy and solid waste do not follow any sequential progression but are interlinked to units and subjects, specifically in chemistry, biology, geography and English. Some of the water concepts cited under this principle is water quality, pollutants, water treatment and water quantity.

In general there were very few concepts covered relating to water quality. Types of pollutants were covered mainly in biology and chemistry in grade 9. Sources of pollution were also discussed in higher grades with some emphasis in geography in grade 6. Quantity of water and its depletion were discussed in higher grades in geography and sciences.

In regards to energy concepts, the economic implications of supply and demand and the price of energy were only minimally covered in the textbooks, specifically in grades 9 and 10. Prices of energy, depletion of energy sources and the social implications of these topics were also covered in higher grades, specifically in chemistry, English and geography. Electromagnetic pollutants were not mentioned and need to be tackled (specifically, for example, the fact that cellular phones have become a necessity even for the poorest).

Solid waste concepts covered under this principle include the definition of waste and its composition, sources of waste, and its decomposition. Finally, the effect of waste on human health, its effect on the environment, its implications are also included. The concepts are covered minimally in textbooks and do not follow a sequential progression of these concepts, and there is an apparent absence of the definition of waste. While

the composition is mentioned in several grades, it is scattered and lacks coherency of treatment. Electronic waste, bulky items, and hazardous waste were either minimally mentioned or absent. Decomposition was not clearly stated, except once in grade 9 chemistry.

The solid waste concepts need to be tackled separately in a more holistic approach and presented in a project-based format that is student-friendly.

Principle 4: Environmental Problems and Issues Related to Human Impact

There are 354 concepts covered in the textbook related to the themes of this principle. Again the concepts were scattered and did not follow a specific rationale.

For water, the problem of water quantity was covered only in grades 5 and above. While the biggest problem in Jordan is water shortage and related quality problems, this issue is only mentioned in grades 8 and 9 in geography, with some mention in Arabic, while other less relevant problems such as floods are mentioned in grades 1, 5, 7, and 10 in science and English. This principle is effectively developed in a sequential way, but its relevancy to the Jordanian context is not emphasized. When discussing the concept of water quality, grades 5, 6, 9 and 10 mention the water crisis in relation to both pollution and shortage, but there is a more significant mention of the idea that supply is a problem because of poor maintenance and/or wearing out of the old water network.

This vast knowledge base in the textbooks was evident when interviewing school students, as they were able to mention many global problems. Yet, when asking students to state the major problem in Jordan, they were unaware that it was water shortages, and many would mention pollution or littering. This fact also is substantiated by the findings of our textbook-mapping, in which scattered concepts of the water crisis and shortage appeared without real reference to or true analysis of the situation.

Of interest for energy concepts, is the deforestation concept, which is mentioned in all grades except grade 2. Other global problems are covered vastly in all subjects as well. nuclear alternatives and their effects are covered only in three grades of geography (6, 7 and 9) and need to be reinforced in other subjects. Furthermore, with the development of Jordanian nuclear energy it has become vital that knowledge is clear to avoid misperception. Also, children should be trained in how to critically evaluate the project.

With regards to solid waste concepts, concepts such as site and land pollution were mentioned in the textbooks. However, littering problems in Jordan were only covered in grade 1 science and in grade 10 in which geography with an apparent gap in between these grades. Furthermore, solid waste management, random dumping and incineration of solid waste were also minimally covered. These concepts are vital for Jordan since littering and its management is a top issue of concern.

It is recommended that specific support material for grade six and seven be produced. The focus of the support materials would be Jordan and the problems of water, energy and solid waste. Specific emphasis would be on water shortage, nuclear energy and littering.

Principle 5: Environmental management

Environmental management concepts are adequately covered for the three themes with a total of 509 concepts in all subjects. However, it was evident that the coverage of water concepts was more equally

distributed showing a more systematically-developed sequence for the concepts. Water concepts covering this principle discuss the importance of water socially, economically, politically and culturally and were tackled from grades 1 to grades 10 in vocational education, English, science, Arabic and mathematics. Some of the important missing concepts are water distribution and its efficiency, laws, regulations and their enforcement, and supply management. These results are interesting since in the survey of students in schools it was clear that many of them had unethical attitudes towards water distribution and water losses. They were unaware of water distribution systems in Jordan and, due to the lack of understanding of laws and regulations, were unaware of the penalties for tampering with the government distribution systems.

The main energy concepts covered are the economic, environmental and cultural importance of energy and the opportunities and challenges that energy poses. The concepts were missing from the earlier grades except for simple references to pictures displaying behaviors in the vocational education curriculum and the Arabic curriculum. The concepts are scattered and do not seem to follow a logical sequential development. There is saturation of concepts in grade 10, while earlier grades experience an absence of such concepts, resulting in a lack of student awareness of energy problems at a young age and a lack of any knowledge base for behavioral change. But as they grow older, concepts become vast and repetitive, which makes the subject unappealing.

In sciences, concepts are adequately introduced in grade 4 and are further enhanced and elaborated upon in grade 5. There is an abundance of concepts in grade 10, mainly in the English, geology, biology, chemistry, and physics textbooks.

It was clear that there was an absence of coverage of historical trends and present-day conditions. The economics of energy as related to supply, demand and market conditions were also missing from the texts.

Awareness of the importance of energy conservation and personal responsibility was reinforced in abundance in all grades. However, this does not necessary mean that behavior and attitude change will come about as a result of increased knowledge, a fact that was verified in an earlier survey of students in Jordan.

Some important missing concepts include market trends for energy, effects of population growth on resource consumption, and energy needs. Also missing are adequate discussions of possibilities and solutions such as the importance of finding alternative energies, the role of alternative energy as a substitute to fossils fuels and nuclear energy, and nuclear energy in Jordan. Another missing concept, which is only present in grade 10 English, is the production of fossil fuels; this fact was apparent during the earlier survey when youth found it difficult to identify the actual sources of energy in Jordan. With little emphasis on fossil fuels in the curriculum, many students considered them as a non-vital energy source for Jordan.

Solid waste under this principle covers wide concepts such as solid waste management, awareness and behavioral change, and the role of media policies, laws and regulations. Other concepts include waste collection and disposal, recycling, reuse, and reduction. Concepts of solid waste management and behavioral change are covered in many subjects. Although anti-littering statements are randomly recurrent, earlier studies have shown that this education has had very little influence on student behavior regarding littering.

Important missing concepts are carbon footprint, collecting and transporting waste, laws and regulations regarding littering, ways of disposal of solid waste, the role of Greater Amman Municipality -GAM and the garbage collectors, as well as technological solutions to waste-related problems.

It is recommended that this principle include the concepts of water distribution and laws and regulations. In regard to energy concepts, the relevancy of market demand, economic and population growth, carbon footprint, and the economics of alternative energy need to be included. In regard to solid waste concepts, discussion should include the 3 R's, "water: from source to sink," ways of disposal and the role of GAM and

garbage collectors. Additionally, supplementary material should be produced for grade 9 in the form of a themed booklet on human impact on the environment and demand management of resources.

Principle 6: Sustainable Development

This principle deals with some of the bigger issues of sustainability, focusing on the role of societies and countries but beginning with the individual. This principle looks at energy, water and solid waste in a holistic approach and evaluates relevant interconnections, but is only covered minimally with 22 concepts appearing in the curriculum.

Most of the concepts related to this principle are missing. Examples of missing concepts include the interaction between water, energy and solid waste, green building, climate change, green engineering, industrial ecology, zero waste, the earth charter and environmentally-friendly cities.

Concepts on sustainable development are all application-based, focusing on the ethics and attitudes behind conservation, such as the Earth Charter. Also included are the efforts of nations and countries to effect change. This communal responsibility facet of the environment is essential to the holistic understanding of both the problems and the solutions.

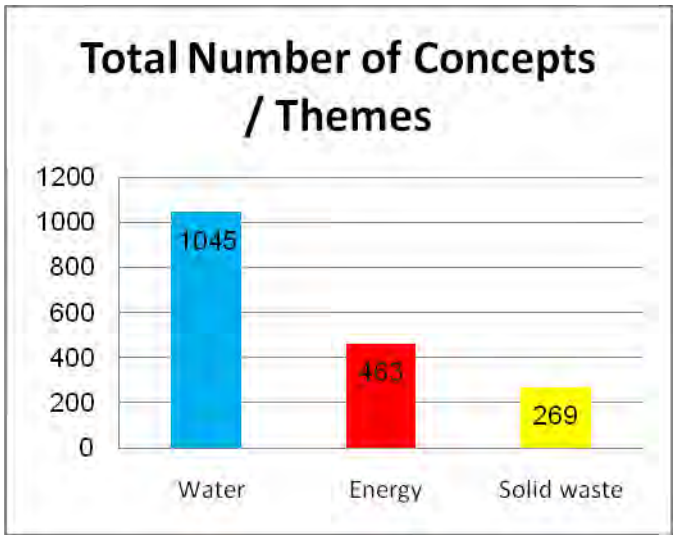
It is recommended that supplementary material be prepared for grade 10 students in which they can be introduced to concepts of sustainable development for critical reflection and evaluation. The booklet will be themed and will surround environmentally sustainable development.

4.0 **GAP ASSESSMENT**

4.1 Theme Gaps

There were a total of 1777 concepts in the textbooks covering the themes of water, energy and solid waste. Water concepts were by far covered most in textbooks. This is the effect of the WEPIA project in which water concepts were infused in the textbooks in 2004. However, despite the vast number of concepts it was evident from earlier studies that attitudes towards water conservation were low and so were behaviors and participation. Energy concepts were moderately tackled, with 463 concepts throughout, and with most information appearing scientific in nature. While solid waste concepts were covered least in the textbooks with a total of 269 concepts, the attitudes of youth when surveyed regarding littering were similar to their attitudes towards water.

Figure 16: total number of concepts/themes



4.2 Principle Gaps

Principle 1 contained few gaps. Much of the Jordanian national curriculum focuses on memorization of theoretical data; therefore Principle 1 appeared throughout via scientific information. The curricula not only contained vast concepts that fall under the first principle, but many of the concepts were also unnecessarily repeated, specifically water eco-systems and sources of energy.

Principle 2 was also covered immensely, with few gaps. The use of natural systems is not difficult to tackle and is impossible to ignore in such a consumerist-based society. An evident, yet crucial, gap was the water uses per sector. The lack of student knowledge of this topic became evident in the previous study when the majority of students wrongly identified the domestic sector as the major user of water in Jordan. Also, yet another critical gap found was the production of energy locally and internationally and its consumption per sector. Evidence of this lack of knowledge also appeared in the previous study when students could not identify Jordan's main sources of energy, and could not identify what generates electricity. Youth shared a common misperception that much, if not most, of the energy used was renewable.

Principle 3 contained more gaps than the first two principles. Gaps in water and energy remained few, but were crucial. The concept of water quality, which is integral to the health of the Jordanian population, only appeared once in grade 9 geography. The curricula did not cover the demand for energy either, nor did it cover the economic impact of energy. The largest gaps appeared in solid waste, as only in principle 3 did the concept of solid waste begin to be introduced, and poorly so. The types of waste, such as medical, industrial, electronic, etc, were minimally tackled. The composition of solid waste and its origins were missing as well.

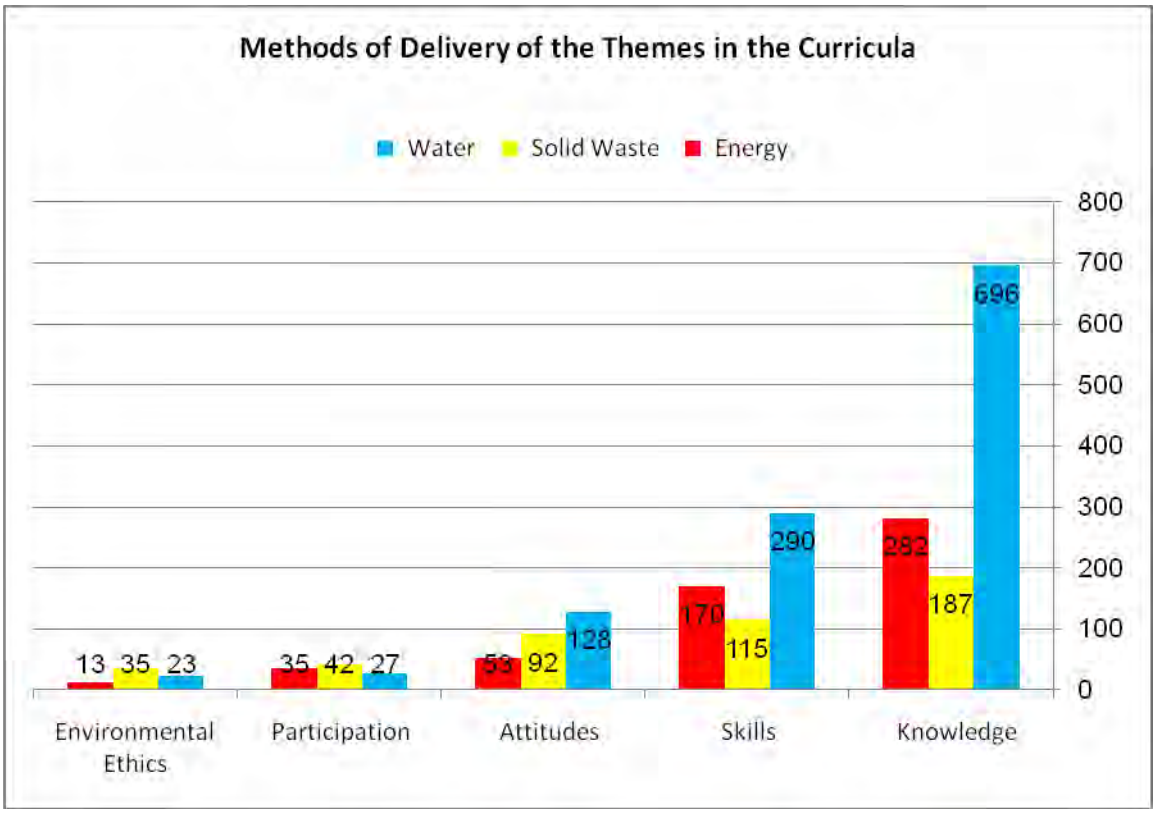
Principle 4 contained multiple gaps, all of which were key to understanding the severity of environmental issues locally and globally. Water issues related to Jordan and around the world were absent, such as water quality, pollution, and crises. Oddly, other global environmental topics such as flooding, drought, and desertification appeared more frequently. With regards to energy, nuclear alternatives were only mildly discussed. The reason for this deficiency may be the only recent relevance of this topic. Solid waste concepts, as with water concepts, lacked information relevant to Jordan and its management of the problems. The curricula failed to tackle waste issues in Jordan, poor management of waste, and burning of waste.

Principle 5 contained the biggest gaps of all the principles. Water management is covered from individual and governmental levels, but the curricula lack information on the collective societal role of managing water resources. Furthermore, the roles of laws and regulations in resource management are not made clear either. Additionally, certain solutions relevant to our geographical and climatic area, such as gray water systems, desert farming, and desalination, are only minimally discussed. Mega-projects, such as the Disi project and the Red-Dead Canal, seldom appear. Moreover, the books lack a holistic approach to energy and do not connect the historical use of energy to the present-day uses, nor do they cover the economics and market shifts, or the carbon footprint. The availability and reliability of energy sources, as well as the effect of population growth on resources act as yet another concept gap. With regards to solid waste, methods of disposal, such as dumping, landfills, and burning, are missing until grade 10.

Principle 6 covers the new approaches to humans' place in the environment. These approaches do not place value on the environment because of humans' need of it, but rather realize that the environment is valuable irrespective of its connection to humankind. These up-and-coming environmental perspectives are missing in the national curriculum, with the Earth Charter, green building, green engineering, industrial ecology, clean production, and climate change all absent.

4.3 Gaps in Methods of Delivery

Figure 17: methods of delivery of the themes in the curricula



The three themes covered in the textbook appear mostly as knowledge. This is consistent with our earlier findings since most of the concepts are tackled as scientific facts and as information with little emphasis on social, economic, political and cultural dimensions of environmental issues.

Skills were present but to a lesser degree. Most of the skills covered were in the form of asking critical question at the end of the unit/lesson, conducting research, writing about visits to institutions, and comparing and reading graphs and figures. These were stated as activities, but a thorough explanation of the methodology needed to implement such activities was not described nor did any evaluations follow. In sciences, most of the skills were in the form of experiments, researching, and drawing graphs and charts. In lower grades, the emphasis was on drawing pictures, comparing photos of behaviors, as well as some sorting exercise. In vocational education some higher skills were introduced such as making electrical circuits or

applying water quality testing techniques, but these skills remained minimal for the subject. In geography most skills focused on drawing maps, researching, suggestions for field visits, and some critical thinking questions that need researching. Solid waste concepts had the highest skills compared to the number of concepts, this is mainly because these concepts were introduced as add-ons to subjects and often were in the form of "to do and not to do" situations.

Attitudes were tackled in the form of situations and selecting positive behavior. While students may select positive behavior to receive a high grade, this does not mean that they actually believe in it, let alone practice it. Furthermore, most of these situational questions came as add-ons and did not follow a progressive thought. To change attitudes, textbooks need to align the environmental values with the values already shared by students and with the collective values of society. By making environmental ethics relevant to youth by relating it to their personal ethics and culture, students will genuinely assume the environmental values, making them an intrinsic, ingrained part of youth and thus future leaders. This progression and method of making the environment pertinent is missing from textbooks.

Participation and ethics were least tackled. The reason is that the lessons and units did not flow in a manner in which thinking skills were progressing to reach towards actions and participation. Changing attitudes and emphasizing participation comes as a final stage to awareness, knowledge and understanding. Moreover, most activities that promote thinking skills are introduced as questions or optional activities. Unless, specific sections in the textbook are assigned for projects, skills and participation, the concepts remain superficially tackled. Furthermore, most activities and projects that promote skills and participation require support materials that include worksheets and background information that can only be presented in supplemental teachers guide material. Currently, the teachers guide is rarely used and does not serve this purpose.

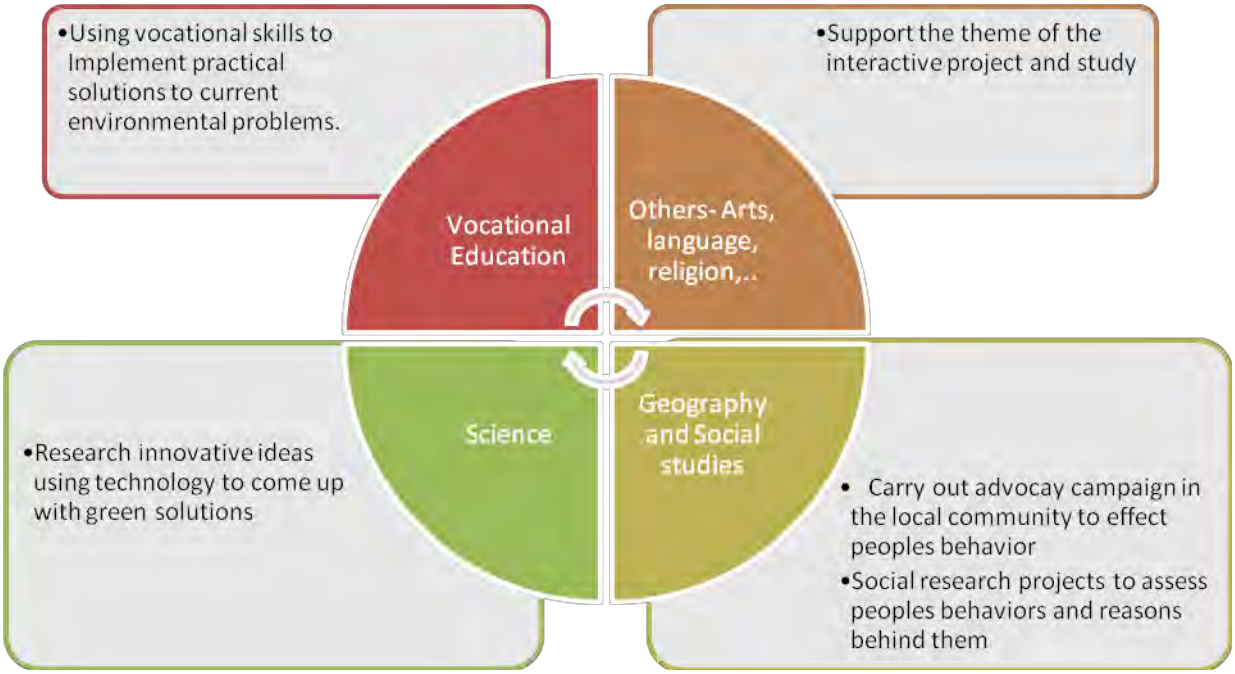
5.0 RECOMMENDATION

5.1 General Recommendations

Developing an understanding of the environment and environmental sustainability depends on students' willingness and ability to ask questions about the world around them, speculate and hypothesize, seek information, and develop answers to their questions. Environmental literacy requires a familiarity with some basic modes of inquiry; a mastery of fundamental skills for gathering, organizing, interpreting, synthesizing, and evaluating information; developing explanations; and communicating these understandings to others. These needs, however, are not reflected in the national curriculum, particularly in the way the concepts are tackled in the textbooks. It is recommended that support programs be included to enhance the curriculum and promote positive attitudes.

Under the vision of ERfKE 2, each school will have a resource center where they will be able to obtain support materials such as environmental bulletins, books, activity workbooks, e-learning materials, etc. One important element of this project will be to introduce as many resources as possible for teachers to use. The teachers will be trained both in the use of the new integrated EE concepts and in enhancing learning through the use of resources from the resource centers.

Figure 18: use of the new integrated EE concepts and in enhancing learning



It is not recommended that any amendments to national curriculum be included in the conventional manner that the textbook present. It has become evident that although knowledge is extensively conveyed in the textbooks, student attitudes remain negative towards the environment. The only real motivation for change arises when children carry out hands-on projects and experiential learning by getting immersed in the issues directly. Thus, the following recommendations are suggested:

- Develop support materials to promote critical thinking, problem solving and to develop positive attitudes, behaviour and ethics among students. The support materials should be in the form of educational packages for earlier grades and support booklets with multiple interdisciplinary projects for later grades.

- Develop e-support software for environmental education projects and provide training in their usage. The software will simulate environmental problems and issues specific to Jordan so that children will be able to visualize and evaluate problems and suggest solutions.

- Train teachers in using the support materials and e-software, and develop a strong network of "environmental green schools." This could be carried out collaboratively with the Queen Rania Teacher Training Academy

- Hold information sessions and seminars for curriculum division members to update them on the newest concepts and on those that need reinforcement in the curriculum. Specific emphasis should be made on solid waste concepts, energy in Jordan, mega-projects, environmental ethics, green building, zero waste and sustainability (see gap chart).

5.2 Specific Recommendations by Grade

Grades 1-4: An "environmental package" should be prepared as a supplement to the curriculum, tackling issues such as solid waste, water and energy in Jordan and consumption rates per sector. It is recommended that greater emphasis be given to energy, solid waste in the earlier grades. The best approach would be to introduce child-friendly material emphasizing learning by play. Audiovisuals, games, booklets, and experiments could be introduced in an interactive package for each student. The packages would include the missing concepts of energy and water contextualized to their local school environment.

Grades 5-7: There is an evident absence of knowledge related to Jordan's rates of consumption of water and energy and thus there is a lack of awareness of the role of the individual in effecting change. There is also an absence of the concepts of shared water resources in Jordan and the inter-linkages between water and energy. It is recommended that for grades 5-7 support materials be produced in which youth can explore the above concepts through research and be able to share their findings with officials and decision makers.

Grades 6-7: A solid waste project needs to be tackled separately in a more holistic approach and presented in a student-friendly, project-based format.

Grade 8: Projects should focus on the problems of water, energy and solid waste in Jordan. Specific emphasis would be given to water shortages, nuclear energy and littering.

Grade 9: Human impact on resources and demand management of resources should be stressed. It is recommended that this principle include the concepts of water distribution and laws and regulations. Regarding energy concepts, the relevancy of market demand, economic and population growth, the concept of carbon footprint, and the economics of alternative energy need to be included. Regarding solid waste concepts, discussions should include the 3 R's, "water: from source to sink," ways of disposal, and the role of GAM and garbage collectors in the waste management process.

Grade 10: Sustainable development should be emphasized. It is recommended that supplementary material be prepared for students in which they can be introduced to concepts of the interaction between water, energy and solid waste, green building, climate change, green engineering, industrial ecology, zero waste, the Earth Charter and environmentally-friendly cities for critical reflection and evaluation.