A Suggested Unit in Science for Developing Green Energy Concepts among the Prep Stage Second Graders and their Attitudes towards it

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Abstract:

This study aimed at developing concepts of green energy among second graders at the prep stage and their attitudes towards it. The sample of the study included 50 female students in second grade of the prep stage. Instruments of the study included a test of green energy concepts and a scale of attitudes towards green energy and its applications. The instruments were administered to the sample, and then a unit on green energy was taught to them. After that, the instruments were administered to the sample again. The results of the study showed the effectiveness of the suggested unit "Green Energy" and that it had a great effect on the sample's acquisition of the green energy concepts and attitudes towards it. The study recommended that the role of the Science curricula should be activated in achieving the aims of green energy as a main goal of teaching Science at the different educational stages. The study also recommended providing the students with enough information and skills about green energy and its applications for developing awareness and attitudes towards it.

Introduction:

There is no doubt that humanity is about to face a great crisis in energy that may start at any time and paralyze everything. Fossil fuel is consumed; the number of cars increases than before and lights are everywhere; cutting down forests and trees is much faster than before, not to mention the growing increase in the Earth's temperature, and the countries' and governments' conflict to seize the sources of energy or the duplication of energy cost much every now and then.

Energy is a basic pillar of economic, constructional, and social development since the world is facing the problem of the

increase of traditional energy sources, especially their lack in the future and their negative effect on the environment. Renewable and nuclear energy are the basic sources of the international energy. There is an international concern of these two sources as future sources of energy that will be alternatives for fossil energy which many countries, especially industrial ones, seek to replace (Emara, 2007).

Therefore, the young should be grown up in a way that is consistent with the requirements of the future, so that they would have a sound cognitive background about renewable, clean, green energy, good understanding of its applications in daily life and at the national level, and positive attitudes towards it. They should also be able to take decisions related to energy in the future.

Recent curricula represent an important component in the educational process because they are a reflection and representation of the content of this process. They, in their form and increasing renovations in the light of the technological society and the era of information revolution, aim at meeting the students' renewed needs, inclinations, attitudes and abilities in addition to their societies' needs. In addition, the educational problems cannot be solved in isolation of curricula which are related to most educational problems in a way or another and bear a part of the responsibility about inability of education to achieve the individuals' and society's goals. (Mousa, 2012: 2).

Therefore, Science curricula witness continuous movement for development, reformulation and reforming since the mid-twentieth in many countries of the world. Some of the most prominent and important international projects in the area of developing Science curricula are "Scope, Sequence and Coordination (SS&C)", "Science for All Americans (2061)", "Science, Technology and Society (STS)", and "National Science Education Standards (NSES)".

These new projects are concerned with developing the positive situations among the learners. This is because the

students' appreciation for Science may be higher when they realize the benefit of Science in their life, its effect on their food, clothes, the spare time they make use of and the level of life they live. All of this is due to Science and recent technology discoveries and innovations, and because all professions are affected by Science (Alhoweidy, 2005).

Scientific concepts are one of the most important learning outcomes through which scientific knowledge is organized in a meaningful form. They are the organizing and directing elements of any scientific information or knowledge introduced in the classroom or the lab. Forming and developing scientific concepts among learners is one of the aims of Science teaching in all different educational stages. It is also considered of the basics of Science and scientific knowledge which benefit in understanding its general structure and transfer of learning (Alnagdy, Abdelhady & Rashed, 2003; Moustafa, 2001).

Developing attitudes, modifying some of them or changing others do not happen merely by providing students with separate rigid facts. Although knowledge and facts are important for forming sound attitudes, they have to be meaningful and functional for the learner. On the other hand, this will not be achieved merely by training. It requires persistence and continuity in order to accomplish the aim of teaching Science in all educational stages (Albaghdady, 2003).

It is natural that our look at teaching, simplifying and disseminating Science changes since we educate the youth to cope with the age and become able to take the responsibility for the development and progress of society. We also prepare the youth to be able to face the individual and group problems in the style and way that suit the different discoveries they have to use and understand, and provide safety means so that they become useful tools that benefit and serve them, not to destroy them (Selim, 2006: 1).

In this respect, the conference of "Teaching Science, Technology and the Future Human Needs" was held in India in

1985. It was concerned with working beyond the traditional frame of the different branches of Science (Physics, Chemistry and Biology). It focused on eight interdisciplinary topics that were considered necessary and of importance to Science Education. They are health, agriculture and food, the environment, information and communication technology, mineral wealth, water and land, technology and industry, social responsibility and morals, and sources of energy (Shabara, 1998: 372).

Some studies were concerned with identifying the fields of the technological and scientific innovations. Others were concerned with identifying the effectiveness of teaching some recent scientific fields in Science and its branches such as Nasr (1997), Ismail (2000), Alzaaneen (2002), Alloulou (2004), Abdelhady (1999), Khalifa (2003), Alweseimy (2003), Aloleimy (2007), Abou Fouda (2010), Alhabahba (2011), National Center for Educational Research and Development (2011) and Lebad (2013). These studies identified the contemporary technological and scientific changes as environmental issues, energy and the future, agricultural sciences and food, medical sciences, medicine and medical industry, genetic engineering, geological sciences, new materials, agricultural technology, technology of education, information and communication technology, food production, population education, astronomy and space exploration, renewable energy, producing vital systems engineering and the technological development of production equipment.

There is no doubt that the issue of energy is an international one that should be integrated in the Science curricula since caring for them is a required matter at this stage in which the energy issue faces a real crisis at the Arab and international levels.

Energy is the main pillar of economy and an important indicator of the peoples' progress. Thus, development rates in every country are closely related to the available sources of energy in order to achieve the development programs where the demand for energy increases because of the technological and

scientific development in all fields. There are many fears about expectations of consumption of energy sources especially the traditional ones such as coal, petrol and natural gas. This fear urged many countries to search for alternative resources for energy. Visions were directed towards the permanent renewable sources such as the solar energy, the wind, waterfalls and tidal energy. Thus, the term "alternative sources of energy", "renewable energy" or "green energy" appeared (Shalaby, 2006: 9).

Based on this increasing importance of green and renewable energy during the last period, it should be paid due concern in Science Education at the national and the international levels. Therefore, some studies have been concerned with developing the students' awareness of the concepts and sources of green and renewable energy such as Kroll (1992) which presented a suggested curriculum that includes seven chapters which include concepts about renewable energy and solar energy. Weiskopf (١٩٩٧) introduced a CD to the sample of his study that included a definition of renewable energy, its sources and effects on society. Martin and O'Toole (2002) introduced presentations about renewable energy for the school students.

Other studies investigated the teachers' attitudes towards sources of green energy such as Liarakou, Gavrilakis and Flouri (2009) which aimed at identifying the secondary stage Greek teachers' attitudes towards sources of green and renewable energy especially the solar system and the wind. This was done through a questionnaire that included a group of open ended and closed questions. Results showed that the teachers do not show clear position towards many issues related to the solar system and wind energy. They also have a relatively low level of belief that sources of renewable energy may be sufficient for the future needs of energy. The study also indicated that such results can't show the extent of teachers' effect on the students' opinions and attitudes towards renewable energy.

Some studies identified the students' awareness of and attitudes towards green and renewable energy. Coker, Catlioglu and Birgin (2010) aimed at identifying the Turkish primary and secondary stage students' knowledge about sources of renewable energy using a group of open- ended questions. The study recommended the necessity of integrating the concepts of energy in different curricula. Alsamoraey (2011) aimed at identifying the extent to which the students in the Faculty of Education and the Faculty of Science in Baghdad acquired the concepts of renewable energy and its relationship to environmental awareness among them. The study showed that the students' acquisition of the renewable energy concepts reached 45% in addition to the environmental awareness acquisition. DeWaters and Powers (2011) assessed energy literacy among the secondary stage students in New York. The results showed that the students were concerned with the problems of energy. Yet, they poorly acquired the concepts and skills which contribute to solving these problems. The study showed a need for teaching that enhances the students' literacy about energy through a scientific content, and affects their attitudes, values and behaviors.

Zyadin *et al.* (2012) identified the students' knowledge, conceptions and attitudes towards renewable energy in Jordon which is a country that extensively depends on fuel energy although it owns sources of renewable energy. A questionnaire was prepared to better understand the role of education in increasing the students' awareness of renewable energy. It was distributed to students in rural and urban areas in Jordon. The results indicated the students' limited ability to discriminate sources of renewable energy from the non-renewable ones. The results also revealed that more than 50% of the students were not aware of biofuels. However, 87% of the students considered renewable energy the best choice in the future. They showed positive attitudes towards selecting renewable energy even if it is costly. In addition, the study showed that females were more knowledgeable about sources of renewable energy than males and those urban students were more aware and more supportive

to renewable energy than rural students. The study asserted the importance of teaching renewable energy as early as possible to encourage the development of renewable energy which is considered necessary for decreasing the danger of the environmental problems related to fossil fuel.

Table 1: Results of analyzing the Science textbooks at the primary, prep and secondary stages

The primary stage	The prep stage	The secondary stage
Grade: Fourth primary **Lesson: Forms and transformations of energy** ***Mentioning using solar cells for generating electric energy in about one paragraph.** **Lesson: Sources of energy** ***Mentioning the importance of the sun and that it is the main source of energy on Earth.** ***A paragraph about the benefits of the solar energy.** ***A paragraph about using solar energy for getting electricity.** ***A paragraph about windmills which control turbines for generating electricity.** ***A paragraph about using solar energy for warming.** ***Mentioning wind energy (in about one line), tidal energy (one paragraph), waterfalls' energy (in about one line) as examples of renewable energy.**	**Grade: First prep** **Lesson: Energy: its sources and forms** ***Giving some examples of sources of renewable energy such as the sun, wind and water movement only.** ***Showing an activity that includes mentioning sun cell, and wind turbines.** **Lesson: Thermal energy** ***Mentioning some examples for some technological applications of renewable energy which produce heat.**	**Grade: First secondary (Physics)** **Lesson: Work and energy** ***A paragraph about renewable energy** ***Mentioning a film on the book's electronic website about the different sources of energy and its environmental effects.**
Grade: Fifth primary **Nothing**	**Grade: Second prep** **Nothing**	**Grade: Second secondary** **Nothing**
		Grade: Third secondary (Physics) **Nothing**
Grade: Sixth primary **Nothing**	**Grade: Third prep** **Nothing**	**Grade: third secondary (Subject: Environmental and Geological Sciences)** ***Mentioning (in about two lines) the importance of using solar, wind and waterfall energy as alternatives for fossil fuel.** ***Mentioning (in about two lines) the necessity of manufacturing cars that work with electricity generated by solar energy.** ***Mentioning (in about one line) transforming animals' wastes to methane to be used as fuel.**

Pradipta *et al.* (2013) aimed at identifying the students' conception and attitudes towards bioenergy in the Finnish, Taiwanese, Turkish and Slovakian schools as indicators of their use of bioenergy in the future. The study showed that the students' intentions to use bioenergy are related to their conceptions of the social and environmental aspects of bioenergy and that the level of the students' knowledge about it significantly affects their intentions to use it in the future.

At the national level, Fouda and Ezzeddein (2015) analyzed the trends of the studies in the Journal of the Egyptian Society of Science Education and its conferences in light of the excellence fields of Science Education. The researchers reached six fields of excellence; recent scientific fields in Science and its branches are among them. The study pointed out the scarcity of the studies that paid concern to recent scientific fields in Science and its branches. The number of studies was five (only 0.81%) out of the total number of studies. In addition, the studies focused on suggesting programs or instructional units in the fields of nanotechnology, genetic engineering and biological war. Only one study focused on the outer space and the universe while no study was conducted on energy and its forms.

The researcher analyzed the primary, prep and secondary stage Science textbooks to identify the extent to which they tackle concepts of green and renewable energy. Table 1 presents the results of this analysis.

It is clear, from table(1), that the Science curricula of the primary fifth and sixth grades, prep second and third grades, the Physics, Chemistry and Biology curricula of the secondary second grade, and Biology and Chemistry curricula of the secondary first and third grades are devoid of the concepts of green and renewable energy. The analysis also showed that the concepts of green and renewable energy available in some Science curricula were mentioned very briefly. It also showed the absence of many of the areas and concepts of green and renewable energy in these curricula. None of these curricula showed the idea how the technological applications of green energy such as solar water

heaters, solar dryers, solar stoves, solar distillates, solar cookers and wind turbines. Pradipta *et al.* (2013) see that the students are the decision makers in the future and that they will play an important role in transferring the society from the style of living that depends on fossil fuel to that depends on green energy.

Therefore, this study attempts to provide the students at the second grade of the prep stage with concepts of green energy and practical applications. This is an attempt to provide the students with the suitable level of knowledge and literacy, develop attitudes towards green energy so that they can keep up with these developments and to prepare a generation armed with concepts and skills to face life, and practice their role positively in community service.

Problem of the study:

Results of analyzing the Science textbooks at the primary, prep and secondary stages showed that the second grade prep Science textbooks are devoid of the concepts of green energy. In the first term, the book dealt with periodic of elements and their characteristics, the atmosphere and protecting the Earth, and fossils and protecting species from extinction. The second term dealt with periodic motion, sound and light, reproduction and continuity of species. It is also completely devoid of the concepts of green and renewable energy. This result is consistent with Ismail (2000), Moustafa, Korany, Abouelez and Aboushama (2007) and Abderraouf (2008) which showed that the prep stage curricula do not include most of the novelties of the area of energy and green and renewable energy. In addition, the scientific material mentioned here and there is old and needs to be renewed to meet the massive development in these areas.

Many studies that evaluated the content of the Science curricula at different educational stages indicated the poor inclusion of the topics and issues related to scientific novelties, their inability to achieve the aims of Science Education and contemporary Science teaching, and scarcity of the studies concerned with the area of energy and its forms generally (Reyad, 2009; Azzam, 1995; Adly, 2010; Ismail, 2000; Hassan,

2006; Alghareeb, Alsadek and Shoeir, 2012 and Fouda and Ezzeddein, 2015).

Many studies recommended reconsidering the planning, organization and preparation of the Science curricula so that they keep pace with the scientific novelties to match the increasing scientific and information development. They also recommended the necessity of linking the Science curricula to the reality of the scientific, life, economic and universal issues and providing the students with the scientific , motor and mental skills which help them to live in a society which uses science and technology in its daily life (Alzaaneen, 2002; Khalifa, 2003; Alweseimy, 2003; Alloulou, 2004 and Ismail, 2000).

Zyadin *et al.* (2012) recommended the necessity that teaching green and renewable energy would take new paths because Science curricula should include the characteristics of green energy or introducing them in a separate curricula and integrating the recent technologies of renewable energy. In addition, the study recommended the necessity of setting a new teaching strategy for infusing the concepts of renewable energy throughout the pre-university stage.

Therefore, this study attempts to provide the second graders at the prep stage with the concepts of green energy and its practical applications through teaching a unit in Science that includes these concepts aiming at establishing a sound cognitive base about it among them, good understanding of its uses in the daily life and forming positive attitudes towards it. It also aims at making them able to take responsible decisions related to energy in the future.

Based on the aforementioned studies, the problem of this study is formulated in the following main question:

What is the effectiveness of teaching a suggested unit in Science in developing the concepts of green energy among the second graders at the prep stage and their attitudes towards it?

This question is divided into the following sub-questions:

1. What is the content of the suggested unit in Science which aims at developing the concepts of green energy among the second graders at the prep stage and their attitudes towards it?
2. What is the effect of teaching the suggested unit in developing the concepts of green energy among the second graders at the prep stage?
3. What is the effect of teaching the suggested unit in developing the prep second graders' attitudes towards green energy and its applications?

Aims of the study

This study aimed at:

1. Preparing a manual for teaching the suggested unit that can be used by the teachers and researchers as a guide.
2. Identifying the effect of teaching the suggested unit in developing the concepts of green energy among the second graders at the prep stage.
3. Identifying the effect of teaching the suggested unit in developing the prep second graders' attitudes towards green energy and its applications.

Importance of the study

The importance of this study lies in the following:

1. It is a response to the results and recommendations of many studies and literature in the field which recommended the necessity of linking the Science curricula to the reality of the scientific, life, economic and universal issues (Alzaaneen, 2002; Khalifa, 2003; Alweseimy, 2003; Alloulou, 2004 and Ismail, 2000).
2. Keeping pace with the increasing concern of green and renewable energy at the national and international levels.
3. Keeping pace with the contemporary international changes in developing positive attitudes towards green renewable energy.

4. Introducing a suggested unit in Science about green energy that may be a guide to the Science curricula designers.

Tools of the study

- Test of the Concepts of Green Energy.
- Scale of Attitude towards Green Energy and its Applications.

Delimitations of the study

This study is delimited to:

1. Preparing a suggested unit in Science about green energy.
2. Experimenting the unit on a sample of the second graders at the Kasem Ameen Prep School for Girls, Alexandria Governorate, Customs Educational Idara.
3. Measuring the students' achievement of the concepts and knowledge of green energy at three levels (knowledge, comprehension and application).
4. Measuring the students' attitudes towards green energy and its practical applications.

Hypotheses of the study

1. There is a statistical significant difference at $p < 0.05$ between the mean scores of the students in test of concepts of green energy before and after studying the suggested unit in favor of the post administration.
2. There is a statistical significant difference at $p < 0.05$ between the mean scores of the students in scale of attitudes towards green energy and its applications before and after studying the suggested unit in favor of the post administration.

Method of the study

This study depended on the descriptive analytic method in preparing the suggested unit and tools of the study. It also used the quasi- experimental design (pre-post one control group) for

identifying the effect of the suggested unit in developing concepts of green energy and attitudes towards it.

Terms of the study

An instructional unit: It is an attempt to organize the experiences of the curriculum, or rather a part of it, in an integrated form to enable the learners to achieve some aims in meaningful ways and significance for them (Addemerdash, 2001).

Green energy: It is clean renewable and environment- friend energy that comes from a natural inexhaustible source. All energy produced by this source can be transformed from one form to another such as the solar energy, the wind energy, waterfalls energy, tidal energy, geoenergy and biomass energy (Ahmad, 2007).

Attitudes: There are many definitions of attitudes, all of them agree that they are learned, i.e. the person can acquire them as a result of involvement and engagement in the situations and external stimuli that affect him in a way or another. As time passes, these attitudes become among the components of personality. An attitude can be defined as the person's general relatively stable feeling which identifies his responses towards a specific topic or issue regarding acceptance or refusal (Annagdy, Rashed and Abdelhady (1999).

Attitudes towards green energy and its applications: It is a situation that expresses the sum of the second grader prep stage student towards the topics of the green energy unit by acceptance, refusal, rejection or opposing.

Review of literature

We live today in a world of increasing change as we live the age of Science. The changes resulting from the scientific and technological development are qualitatively and quantitatively enormous and affect the individuals, societies and nations. Not all the changes happening in the world today are considered the reason of our happiness and welfare of our life. Many of them have severe harms on our health and life. Environment pollution

became a phenomenon we all feel that the environment is no longer able to balance its elements. The cities' atmosphere becomes polluted with the gases coming out of the cars and the factories' chimneys. The ratio of Co_2 in the air increased leading to an increase in the temperature. The ozone layer is affected leading to man's exposure to dangerous diseases. Besides, environmental pollution with petrol wastes leads to endangering the lives of man, animals and plants (Annagdy, Rashed and Abdelhady, 1999).

The studies showed that the rate of world consumption of energy is continuously increasing due to the increasing growth of population and economic growth as well as the increase of the rate of energy consumption per person. Nowadays, the rate of increase in the sources of fossil fuel matches the increasing demand on energy but in the future there will be a shortage. Continuing on the principle that fossil fuel is the main and sole source of energy, and due to burning it, fuel will lead to aggravation of CO_2 increase problem and the greenhouse phenomenon, thus leading to a significant increase in Earth's surface temperature and pollution of the environment (Emara, 2007).

Pradipta *et al.* (2013) assert what has beed said saying that developing the sector of recent bioenergy is an important step towards the society's call for limiting the emission of CO_2 and using environment- friend energy.

Consequently, Emara (2007) sees that the main motive of caring for renewable energy is the environmental motive to limit the emitted gases especially CO_2.

Traditional sources of energy receive a great pressure and an increasing decrease in a period after the collapse of the Soviet Union due to the increasing demand for it. The role of the sources of renewable energy is considered so important to meet the need for energy in the future especially in the population sector (Bahtiyor *et al.*, 2011).

Nigeria's government set a goal to become among the biggest 20 countries in economic in 2020. Therefore, it seeks to achieve sustainable economic growth through a green energy system and developing green energies in all regions in the country as one of the ways to be used for achieving green energy (Akinwale, Ogundari, Ilevbare & Adepoju, 2014).

Using the sun, as a source of energy, is considered among the alternative sources to petrol upon which future hopes are built because it is clean inexhaustible energy. Therefore, many countries are concerned with developing this source and consider it an aim to be achieved. Solar energy is currently used in heating water, warming and cooling as well as in desalination and producing electricity.

Green energy is characterized by some characteristics that distinguish it from other sources of energy. It is:

- Available,
- A national source that does not move, and is compatible with the reality of developing the remote and rural areas and their needs,
- Clean and does not pollute the environment and preserves general health,
- Economical in many uses and has a big economic return,
- Continuously and regularly available with a suitable cost,
- Does not cause any noise or leaves any harmful wastes that pollute the environment,
- Achieving environmental, social, industrial and agricultural development nationwide and
- Using uncomplicated technology and can be locally manufactured (Lehabeeb, 2014).

In Egypt, nonrenewable energy has the biggest ratio where petrol represents 95% of the sum total of the primary energy consumed. Egypt is considered a developing country and in an increasing need for energy to achieve the desired development in all fields: agricultural, industrial, etc. Although Egypt is a petrol

producing country, it is poor in sources of energy since the petrol it produces will suffice it for only tens of years and it does not have any coal supply.

Therefore, there is a need to search for alternatives for energy. These alternatives should be renewable and do not harm the environment and preserve it. Renewable energy such as solar energy, wind energy, biomass energy, tidal energy, and geothermal energy proved to be successful as alternative resources of energy in many studies on the Egyptian conditions (Shalaby, 2006: 14).

A symposium about green energy in Texas concluded that enlightening dialogue about alternatives of energy lead to concern about and support for these resources. In addition, the different kinds of alternative resources of energy such as the wind, biogas and biomass were discussed in addition to stations of energy generation and their effect on the citizens, noise, scent and danger of explosion, etc. (Bahtiyor *et al.* 2011).

Renewable energy includes the solar energy with all its kinds: using the energy of the sun rays through photovoltaic cells, the solar thermal, wind energy, biomass resulting from the plants and animals wastes, geothermal energy resulting from gases and the heat, hydropower, tidal power resulting from the seas' water and wave power (Emara, 2007).

Governments seek to widen the ability of generating electricity from resources such as solar energy stations, wind turbines, hydroelectric turbines and biomasses (Fast and McLeman, 2012). Egypt also seeks to develop the use of renewable energy resources. Organization of New and Renewable Energy was established in 1986 and a strategy for the renewable energy was prepared in 2008 aiming that renewable energy would contribute 20% of the total of the generated electrical power by 2020. The first station for generating electricity from the solar energy was established in Alkorimat

and solar cells were used in the remote areas far from the electricity network (Organization of New and Renewable Energy, 2014).

However, there are some difficulties that face the process of decision making related to renewable energy such as the negative conceptions and attitudes towards renewable energy as a result of lack of the individuals' awareness of information published about renewable energy and their lack of participation in the projects and alternatives of energy. Consequently, the society's awareness of this energy should be developed. Educational curricula are considered the most effective method for building integrated knowledge and encouraging critical thinking about renewable energy in the general and specific applications (Liarakou, Gavrilakis & Flouri, 2009: 120-121).

Therefore, some studies were concerned with identifying the citizens' knowledge and attitudes towards green energy such as Bahtiyor *et al.* (2011) which aimed at identifying the citizens' conceptions about green energy common in Khorezm, Uzbekistan. The study showed that the high cost of green energy and its inability to completely replace the traditional energy are hindrances against renewable energy. However, when financial fund and general awareness are available, they may be motives for this.

Fast and McLeman (2012) identified the citizens' attitudes towards renewable energy technology. An electronic survey was conducted at the beginning of 2011 in the rural eastern Ontario. Participation was high (n= 180, rate of response= 22%). The results revealed strong backup for pursuing the resources of alternative energy (89%). The citizens' backup for solar energy applications was high (87%), for wind turbines and hydroelectric energy was low (58%). The study also showed that rural residents had positive attitudes towards the alternative kinds of producing energy.

Akinwale, Ogundari, Ilevbare and Adepoju (2014) aimed at describing and analyzing the extent to which the citizens

understood the sources of green and renewable energy and their attitudes towards getting them easily and development in Nigeria. The study indicated that a great number of the citizens had knowledge about renewable energy but they didn't understand them deeply. Most of them backup using renewable energy instead of Benzene and they were ready to pay more for electricity supply from green clean energy.

Therefore, many countries prepared educational programs that aimed at developing the students' skills and awareness of the resources of renewable energy. Some of these programs are:

- The project "Green Research for Incorporating Data in the Classroom (GRIDC)" in the U.S.A. aimed at developing higher order thinking skills among the students through collecting comprehensive data about renewable energy (DeLuca, Carpenter & Lari, 2010).
- The program "Mathematics-Science-Engineering-Technology in Iowa on Applied Renewable Energy Areas (MSETI-AREA)" aimed at developing the prep and secondary stage students' understanding of the relationship between Science, technology, engineering and mathematics (STEM) through their applications in the areas of renewable energy (Pecen, Humston & Yildiz, 2012).
- The project "Wind for Schools" was in the U.S.A. about the benefits of wind energy (U.S. Department of Energy's (DOE's), 2007).

In addition, the American Energy Information Administration (EIA) prepared a group of books, films, educational videos, trips, interactive computer programs and workshops for raising the students' awareness of renewable energy (Leonard, 1998). It also prepared an educational program for New Mexico Solar Energy Institute that aimed at enhancing the teachers' ability to teach renewable energy resources (Morgil at al., 2006).

Secken (2006) prepared an instructional material for the primary stage in the form of a puzzle that aimed at teaching them sources of energy and the advantages and disadvantages of renewable energy. Malaysia established Center of Education, Training and Research in Renewable Energy and Energy Efficiency (CETREE) aiming at teaching and training renewable energy to Malaysians and raising their awareness about them (Ibrahim& Hilme, 2007).

Procedures of the study:

First: Preparing the unit:

1. Identifying the aims of the unit:

Educational aims identify learning outcomes the learners are expected to achieve after finishing studying a specific topic or a specific instructional unit. This means that we can identify through them kinds, levels and conditions of learning we want to achieve through the teaching and learning activity and on which we, finally, can identify the extent to which the learners achieved kinds of expected learning. Thus, identifying the instructional aims is a basic stage in the instructional learning process (Alhoweidy, 2005).

By the end of studying the green energy unit, the students will be able to:

1. Define the concept “green energy”.
2. Name the different kinds of energy.
3. Distinguish between the energy polluting and destroying the environment on the one hand and green energy on the other.
4. Deduce the advantages of solar energy.
5. Identify the different forms of solar energy stations.
6. Infer the dangers of not using solar energy.
7. Relate using solar energy to preserving human life.
8. Recognize the future of solar energy.
9. Infer the international and national efforts for using solar energy.

10. Infer the factors that stimulate using wind energy as green clean renewable energy than fossil fuel.
11. Explain how to generate wind energy.
12. Identify the components of turbines.
13. Gives examples of the uses of wind energy.
14. Deduce the advantages of wind energy.
15. Identify the disadvantages of wind energy.
16. Distinguish the different kinds of wind turbines.
17. Identify the different applications of wind energy.
18. Explain methods of getting energy from seas and oceans.
19. Deduce advantages of wave and tidal energy.
20. Identify the advantages of electrical power generated from water sources.
21. Explain method of getting tidal energy.
22. Appreciate the efforts of science and scientists in searching for different kinds of green clean renewable energy.
23. Appreciate the country's efforts of using the different kinds of green clean renewable energy.
24. Appreciate the role of mass media of raising the awareness of the different kinds of green clean renewable energy.
25. Acquire a positive attitude towards using the different kinds of green clean renewable energy.

2. Preparing the content of the unit:

The content of the unit was prepared in the light of the identified aims with the help of the Arabic and foreign references and books that dealt with this topic. The content included a group of direct and indirect experiences taking into consideration the logical and psychological organization when organizing the content. The unit included the following topics:

Topic 1: Solar energy:

- Solar energy: A historical overview

- The solar cells.
- Advantages of solar energy.
- Uses of solar energy.
- Solar energy and agriculture.
- Crises that happens when not using solar energy.
- Solar energy in the Arab countries.
- The future of solar energy.

Topic 2: Wind energy

- How to generate wind energy
- Components of air turbine.
- Kinds of air turbine.
- Uses of air turbines.
- Wind energy and producing hydrogen for energy.
- Wind energy and the electric car.

Topic 3: Wave and tidal energy

- Seas and ocean's energy.
- Electric power generated from water.
- Advantages of hydroelectricity.
- Energy of seas and oceans' waves.
- Tidal energy.

3. Identifying the teaching strategies and instructional activities:

Teaching strategies are an important factor of the curriculum as they closely relate to the objectives and content. They also greatly affect the choice of the activities and teaching aids to be used in teaching Science. They highly contribute in achieving the aims of teaching Science as they identify the teacher's and learners' role in the educational process. They are also used in organizing information and the educational experiences to be introduced to the learners and identify the styles and steps to be followed, the aids to be used and the activities to be carried out (Moustafa, 2001).

A group of strategies that suit the topics of the unit such as discussion, brainstorming, inquiry, problem solving, cooperative learning and demonstrations were selected.

Some of the aids and instructional activities used in teaching the unit are:

- Using demonstrations.
- Showing a group of instructional films related to the topics of the unit.
- Making use of some pictures and drawings.
- Assigning some students to prepare posters that stimulate and encourage using green energy.
- Assigning some students to collect some articles that dealt with the topics of the unit from magazines and newspapers.
- Making use of some simplified Science books that dealt with the topics of the unit.

4. Validating the unit to make sure of its suitability

The unit was submitted in its initial form to a panel of jury members interested in Science Education to get their opinion concerning:

- The general form of the unit.
- The extent to which the unit is suitable to the students at the second grade of the prep stage.
- The extent to which the content of the unit relates to its aims.
- The extent to which the topics of the unit are sequenced and related to each other.

Some paragraphs in some topics were rephrased in the light of the jury members' opinions.

Second: preparing the teacher's guide

Teacher's guide is one of the factors of controlling the experimental variable since it presents a manual and guide to the

teacher to get some suggestions that benefit in teaching the unit. The guide included:

- Some teaching strategies from which the teacher can select when teaching the topics of the unit.
- Aims of the unit.
- Models of the lessons in the unit and how to teach them.

Third: Preparing the instruments of the study

1. Test of Concepts of Green Energy

Aim of the test: The test aims at measuring the scientific concepts and knowledge included in the unit "Green energy" among the second graders at the prep stage at the knowledge, comprehension and application levels.

Formulating test items: Test items were formulated as multiple choice with four responses paying attention that the items be distributed to the topics of the unit. The test in its initial form consisted of 50 items.

Test validity: The test in its initial form was submitted to a panel of jury members specialized in Science Education to give their opinion concerning:

- Correctness of the test items concerning phrasing and scientific content.
- The extent to which the test items are related to the topic of the unit.
- The extent to which the test items represent the cognitive level to which they belong.

Phrasings of some test items were modified and some items were omitted in the light of the opinion of the panel of jury members.

Piloting the test: The test was piloted on a sample of second graders at the prep stage (n=60) other than the sample of the study in order to:

- **Estimate test reliability:** Test reliability was estimated using Kudor Richardson (21). The reliability coefficient was 0.76 which indicates that the test has high reliability.
- **Estimate test duration:** The suitable time for all students to finish answering all test items was 50 minutes.

The final form of the test: After making the modifications and omitting some items in the light of the panel of jurors' opinions, the test included 45 items. One score was given to each correct answer and a zero to each wrong answer. Thus, the total score of the test is 45. Table 2 presents the test specifications.

Table 2: Specifications of the Test of Concepts of Green Energy

Cognitive levels / Topic	Knowledge	Comprehension	Application	Total	Relative weight
Solar energy	17،14،3،2،1 45،44،24،	13،9،8،7،4 22	،19،12،11،6 43	19	%42.22
Wind energy	40،21،20	،38،27،18 41،39	37،15،10،5 42	13	%28.89
Tidal energy	،32،26،23 34	،31،30،25 33	،29،28،16 36،35	13	%28.89
Total	15	15	15	45	
Relative weight of cognitive levels	%33.34	%33.33	%33.33		%100

2. Scale of Attitudes towards Green Energy and its Applications

Aim of the scale: Measuring the change that happened to the sample's attitudes towards green energy and its applications after finishing studying the suggested unit.

Dimensions of the scale: After reviewing some references and studies related to the topic of the study, the following three dimensions were identified:

- Attitude towards studying green energy.
- Attitude towards using green energy.

- Attitude towards protecting the environment.

Formulating statements of the scale: A group of statements about dimensions of the scale were formulated in a three – point Lickert Scale (agree, not sure and disagree). Half of the statements were formulated to measure positive attitudes and the other to measure negative attitudes. Three scores were given for the positive response, two for not sure and one for negative response. The total number of the statements in the scale in its initial form was 60 items.

Validity of the scale's statements: The scale in its initial form was submitted to a panel of jury members specialized in Science Education to give their opinion concerning the extent to which the statements represent the three dimensions comprising the scale. Some statements were reformulated, others were replaced and some were omitted in the light of the opinions of the jury members.

Piloting the scale: The scale in its initial form was administered to a sample of second graders at the prep stage (n=60), the same who participated in piloting the test of the concepts of green energy in order to:

- **Estimate scale reliability:** Reliability of the scale was estimated using Kudor Richardson alpha. The reliability coefficient was 0.78 which indicates that the scale was highly reliable
- **Estimate duration of the scale:** The suitable time needed for all students to respond to all statements of the scale was 30 minutes.

The final form of the scale: After making the modifications suggested by the panel of jury members, the final form of the scale included 50 statements. Thus, the maximum score of the scale is 150 and the minimum is 50. Table 3 explains specifications of the scale of attitudes towards green energy and its applications.

Table 3: Specifications of the scale of attitudes towards green energy and its applications

Statements Scale / dimensions	Positive	Negative	Total	Relative weight
Being interested in studying green energy	46،44،22،20،17	42،39،37،21،18،9،1	12	%24
Using green energy	19،15،13،12،11،8،4 43،38،35،34،32،29،23،	36،33،28،27،24،7،6،5	22	%44
Protecting the environment	50،48،41،25،16،10	49،47،45،40،3130،26،14،3،2	16	%32
Total	25	25	50	100%

Fourth: selecting the sample:

Sample of the study consisted of 50 female students in Kasem Ameen Prep School for Girls, Custom's Educational Idara in Alexandria Governorate during the academic year 2014/ 2015.

Fifth: Administering instruments of the study

1. **Administering the instruments before the intervention:** The test of concepts of green energy and the scale of attitudes towards green energy and its applications were administered to the sample before teaching the suggested unit "Green energy".
2. **Teaching the suggested unit:** The suggested unit was taught to the sample by the classroom teacher with the help of the teacher's guide. Administering the instruments and teaching the suggested unit lasted for 15 periods during the first term of the academic year 2014/ 2015.
3. **Administering the instruments of the study after the intervention:** The test of concepts of green energy and the scale of attitudes towards green energy and its applications were administered to the sample after finishing teaching the suggested unit "Green energy".

Results of the study:

First: Results of administering the test of green energy:

1. To verify the validity of the first hypothesis which states "There is a statistical significant difference at p <0.05 between the mean scores of the students in test of concepts of green energy before and after studying the suggested unit in favor of the post administration", the sample's mean scores in the pre-posttest as a whole and for each level were calculated. Figure 1 presents a graphic representation of the means.

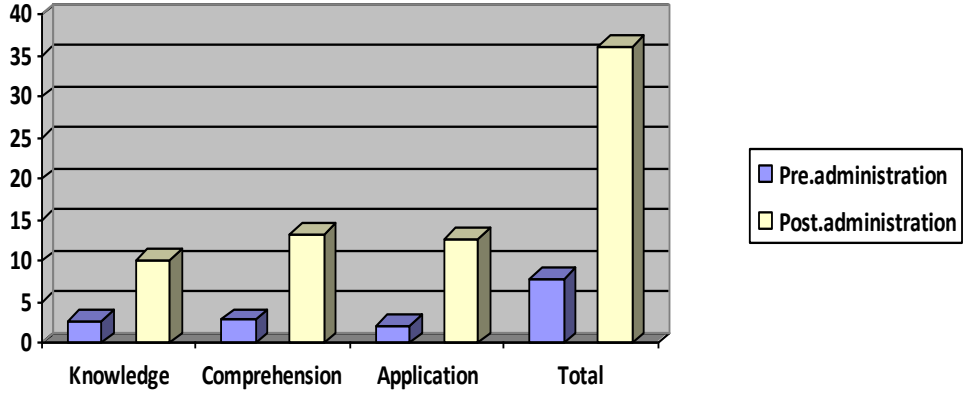

Figure 1: A graphic representation of the sample's mean scores in the pre-posttest as a whole and for the levels of the test

It is clear from graph 1 that:

- There is a difference between the sample's mean scores in the pre-posttest of concepts of green energy as a whole.
- There is a difference between the sample's mean scores in all levels of the pre-posttest of concepts of green energy.

To identify the significance of the differences, t-test was used. Table 4 shows t- value and its significance, 2 for the size of effect and Black's modified gain ratio for the results for the test of concepts of green energy before and after studying the suggested unit.

Table 4: Mean, standard deviation, t-values, size of effect (2) and Black's modified gain ratio for the test of concepts of green energy before and after studying the suggested unit (n=50 students)

Cognitive level	Pre-administration		Post-administration		t-value	Level of significance	Size of effect η2	Black's modified gain ratio
	Mean	SD	Mean	SD				
Knowledge	2.8	1.161	10.22	1.27	30.08	0.01	0.99	1.39
comprehension	2.9	1.025	13.26	1.55	39.09	0.01		
Application	2.2	0.95	12.64	0.975	53.33	0.01		
Total	7.9	1.65	36.12	1.99	76.26	0.01		

It is clear from the previous table that there was a statistically significant difference between the mean scores at the 0.01 of the sample in the pre-post- test of concepts of green energy as a whole and its three cognitive levels in favor of the post- test. This indicates that teaching the suggested unit in green energy had positive effects in developing the concepts of green energy among the sample of the study.

Thus, the first hypothesis of the study proved to be valid. Concerning the effect size of the suggested unit on developing the concepts of green energy, the value of 2 indicated that 99% of the variance between the sample's scores in the pre-posttest is attributed to teaching the suggested unit.

To investigate the effectiveness of the suggested unit, Black's modified gain ratio was calculated. It reached 1.39 which indicates that the content of the unit was effective, i.e. it achieved its aims.

Second: Results of the scale of attitudes towards green energy and its applications

To verify the validity of the second hypothesis which states "There is a statistical significant difference at p <0.05 between

the mean scores of the students in scale of attitudes towards green energy and its applications before and after studying the suggested unit in favor of the post administration", the sample's mean scores in the pre and post administration of the scale as a whole and its three dimensions were calculated. Figure 2 shows a graphical representation of the mean scores.

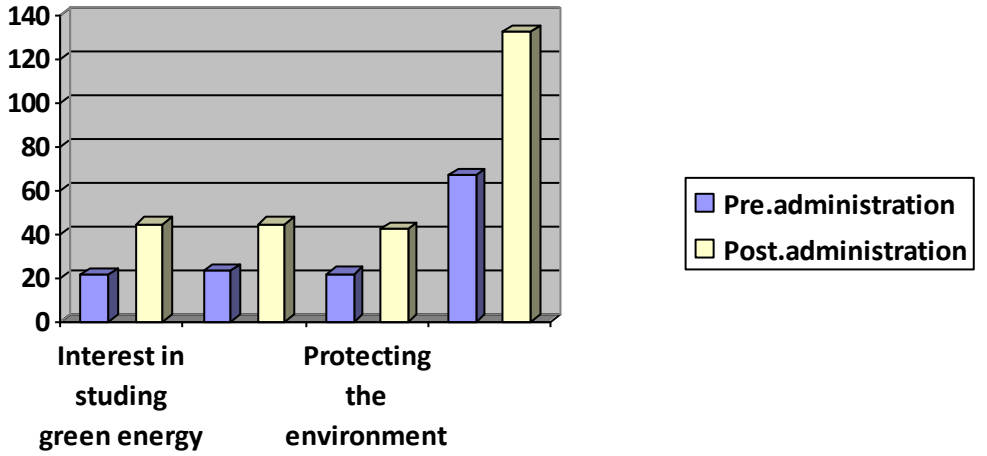

Figure 2: A graphical representation of the sample's mean scores in the pre- post administration of the scale of attitudes as a whole and its three dimensions

It is clear from the previous figure that:

- There is a difference between the sample's mean scores in the pre- post administration of the scale of attitudes as a whole.
- There is a difference between the sample's mean scores in the dimensions of the pre- post scale of attitudes towards green energy and its applications.

To identify the significance of the differences, t-value was calculated. Table 5 presents t-value and its level of significance and effect size using 2 for the results of the scale of attitudes towards green energy and its applications before and after teaching the suggested unit of green energy.

Table 5: Mean scores, standard deviation, t-value and effect size η2 for the results of the scale of attitudes towards green energy and its applications (n=50)

Dimensions of the scale of attitudes	Pre-administration		Post-administration		t-value	Level of significance	Effect size η^2
	Mean	SD	Mean	SD			
Interest in studying green energy	21.6	4.323	44.8	3.64	28.87	0.01	0.97
Using green energy	23.5	5.947	44.8	4.900	19.32	0.01	
Protecting the environment	21.8	4.00	42.3	1.828	32.45	0.01	
Total	66.9	7.96	131.9	6.963	42.68	0.01	

It is clear from the previous table that there was a statistical significant difference at 0.01 level between the sample's mean scores of the total and three dimensions in the pre-post administration of the scale of attitudes towards green energy and its applications in favor of the post administration. This indicates that teaching the suggested unit in green energy had positive effects in developing the sample's attitudes towards green energy and its applications.

Thus, the second hypothesis proved to be valid. Concerning the effect size of the suggested unit on developing the sample's attitudes towards green energy and its applications, the value of 2 showed that 97% of the variance between the sample's scores in the pre-post administration of the scale of attitudes is attributed to teaching the suggested unit which indicates the effectiveness of the suggested unit in developing the attitudes towards green energy and its applications.

Discussion of the results:

Based on the previous presentation of the results, the following conclusions may be drawn:

The results proved the effectiveness of the suggested unit "green energy" and that it had a great effect on the students' acquisition of the concepts of green energy and attitudes towards it since results of the test of concepts of green energy and the

scale of attitude towards green energy and its applications revealed that the differences in the sample's mean scores before and after studying the unit were 28.22 and 65 respectively and that these differences were statistically significant at the 0.01 level in favor of the post administration.

This result agrees with the results of some studies that were concerned with developing the students' awareness of the concepts and sources of green and renewable energy such as Kroll (1992) which introduced a suggested curriculum consisting of seven chapters that included the concepts of renewable energy and solar energy. This result also agrees with Weiskopf (1997) in which the researcher introduced a CD which includes definition of renewable energy, its sources and effects on society to the sample and Martin and O'Toole (2002) in which the researchers presented demonstrations about renewable energy to the students. Besides, the result agrees with Alsamoraey (2011) which showed that the Faculty of Education and Science students' acquisition of the concepts of green energy reached 45% in addition to their acquisition of environmental awareness and Coker, Catlioglu and Birgin (2010) which recommended the necessity of infusing the concepts of green energy in the curricula. In addition, the results agree with DeWaters and Powers (2011) whose results indicated the students' concern with the problems of energy and showed the need for teaching that enhances the students' literacy about energy through the content and affecting students' attitudes, values and behaviors. Furthermore, the results are consistent with Zyadin *et al.* (2012) whose results indicated that 87% of the students consider renewable energy the best choice in the future and showed positive attitudes towards selecting renewable energy even if it is costly. The study also showed that the females were more knowledgeable about sources of renewable energy than males and that those from urban regions were more aware and more supportive to renewable energy than those from rural regions.

Recommendations of the study:

In light of the results of this study, the following is recommended:

- The necessity of activating the role of the Science curricula in achieving the aims of green energy as a main aim for teaching Science at the different stages.
- Providing the students with enough information and skills about green energy and its applications in order to develop awareness of and attitudes towards green energy.
- Developing the Science curricula at the prep stage in a way that achieves activating its role in supporting green energy and its applications.
- Enhancing cooperation between the stakeholders at the Ministry of Education and those concerned with green energy in order to plan and implement a comprehensive program in the field of green energy for all the stages of general education.
- Conducting training programs for the Science teachers aiming at deepening their understanding of the concepts of green energy and developing attitudes towards it.
- Enhancing coordination between the Ministry of Education efforts and those of mass media in the field of developing awareness of green energy and its applications.

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