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Teaching Children to Value Solar Energy

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In this educational initiative, we suggest to build a real model of solar village inside the school, which uses only solar energy. These educational initiatives emphasize the importance of energy for a technological society and the advantage of alternative energy sources. In this scientific educational initiative, the pupils in three elementary schools in Israel were active participants in building systems that use solar energy to work. The study objective is to examine the educational, social and scientific impact of the initiative on students, parents and teachers and their readiness to support and participate in such educational initiative. The study results showed that the three groups highly appreciate the project educationally and socially. They feel that the execution of the initiative inside the school promotes creativity and thinking ability among students. Parents showed a great support for the project, because they see the positive impact of the project on their children's learning ability. Teachers considered this initiative quite important due to the students' interaction and interests, which leads to the success of the school. It also improves the learning skills of the students, such as reading plans, executing research and writing reports.

Keywords: educational initiative, environmental education, science and technology education, solar village

Introduction

The word "energy" means the ability to do work. The need of energy in the world increases to very high dimension because of natural growth and the use of new technology. The sources of the combustible fuels we depend on, such as coal, oil and gas, are finite. In addition, the increased burning of fossil fuels raises concerns over global warming and where controls are lax, air pollution. Since we are becoming so dependent on fossil fuels for energy and they are running out, it is necessary to find alternative energy sources and one alternative energy source is the sun (Carless, 1993; CAT (Centre for Alternative Technology), 2001; Tomas, 1996; White, 1979).

Solar energy is energy from the sun. Solar energy is, in general, generated with the aid of photovoltaic cells from sunlight. Photovoltaic cells are made of very thin layers of silicon, which absorb sunlight and convert it directly to power electricity appliances (Cantrell, 1978; Davis, 1983; Headley, 1979; Ward, 1991).

Using solar energy in the school exposes new technology before the pupils and teaches a new method in preserving energy. This educational initiative emphasizes the importance of energy for technological society and especially alternative energy sources, are quite, do not create pollution, do not require much land and water to operate and can be used to generate both electricity and fuels.

In this educational initiative, we suggest to build a real model of solar village inside the school (Hugerat,

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Ilyian, Zehava, & Anabosi, 2003), which uses only solar energy (National Energy Foundation, 1990a; 1990b; 1991). These educational initiatives emphasize the importance of energy for a technological society and the advantage of alternative energy sources (National Energy Foundation, 1990a; 1990b; 1991). In this scientific educational initiative, the pupils in three elementary schools in Israel were active participants in building systems that use solar energy to work (Hugerat, Basheer, Aliyan, & Nabwani, 2002; Hugerat et al., 2003).

The schools are an ideal place to use solar energy. Changes and improvement at schools are highly visible and closely followed. Bringing solar energy as an educational initiative to schools increases the use of solar energy in the community at large. When the educational initiative starts to work, the school will host the solar energy systems that will become a commonplace tomorrow in public buildings, homes and businesses. Schools make a good showcase for the benefits of solar photovoltaic electricity and pupils will educate their parents that solar energy is clean, limitless and using the sun for lighting, heating and cooling.

The youth of today feel disenfranchised by their elders. All they hear about is how dire their environmental future is and how little effort previous generations are putting into change. By encouraging the installation of solar power in their schools, students will see firsthand the benefits of natural energy and grow up interested in its uses and production. With so many future careers in the green energy sector, this will provide them with the drive and enthusiasm they will need to succeed in it (Narayanaswamy, 2001; NREL (National Renewable Energy Laboratory), 2001).

In this study, we focused on the effects of the educational initiatives, in general, and on the effects of the solar energy village on students, parents and teachers, in particular.

Necessary Conditions for Building and Executing the Initiative

The necessary conditions for building and executing the initiative are as follows:

(1) There must be a search for a solution of any problem that may come up whether social, economical or low achievement in learning. This may help also in bringing new ideas and developing new methods that lead to sounder plan for the initiative;

(2) The principal must be open to adopt new ideas and encourage new initiatives at school;

(3) The school faculty must be professional and each one is specialized in his teaching subject, possesses good experience in teaching and is willing to expend the time and effort for the initiative;

(4) Encouragement from the school superintendent offers support for the faculty and the school to carry out the initiative;

(5) Budget is the most important condition for the implementation of the initiative. Many components of the initiative depend on having the appropriate budget;

(6) Encouragement of initiatives among the non-professional teachers at school and among parents. It is important to publish the initiatives in local and international journals.

Operations Goal and Working Program

The First Goal

Preparing a studying school program, this will contain the followings:

(1) Teaching the teacher about sun energy, their uses and the need of this energy in enhancing advanced technology. In this step, it is very important that the teacher has an experience in different technology methods and prepares a studying material for the pupils about the solar energy subject for the solar village;

(2) The teacher tours the place that uses solar energy in daily life or the place that investigates the solar energy.

The Second Goal

The second goal is to expose the subject of the educational initiative to the pupils. Here, we exposed the advanced technology instrument on the subject of solar energy before the pupils (see Figure 1).

Figure 1. The teachers introduce the solar energy instruments for the pupils.

The Third Goal

In activities with investigation group, the pupils deal with the scientific, technological and social aspects of solar energy. It will introduce the pupils to an investigation and activities on the subject of solar energy are the teacher instructions. The pupils will work as a team, as they construct the solar kits which operate through solar energy (see Figure 2).

Figure 2. The pupils work in groups guided by their teacher.

The Fourth Goal

The pupils will build a big model of solar village inside the school; everything which needs energy will use the solar energy, such as lighting, TV, computer, communications and transport. In the following picture, notice the water pumb which operates with solar energy (see Figure 3).

Figure 3. The pupils examine the produced instruments in the school yard.

The pupils build a small car which moves in the school courtyard, as shown in Figure 4.

Figure 4. A pupil is testing a solar energy car in the school yard.

The Educational Initiative Effect

The Educational Initiative Effect on Students

The implementation of the educational initiative has a tremendous effect on students. It provides students with concepts and expressions relevant to the researched subject, which they cannot perceive and comprehend without such initiatives. We may summarize the benefits of the initiatives and its effect on students in the following points:

(1) Students gain basic concepts and expressions that they can relate to their living environment. They

learn how to deal with environmental phenomena, analyze causes and outcome of things they observe and examine the relations between such things. This process helps students to develop different thinking styles and develop a comprehensive perception for the different phenomena;

(2) Students improve different skills, such as reading plans and diagrams, carrying out research and preparing major assignments;

(3) Students develop curiosity and concern about the surrounding environment and motivation to study it. The implementation of such initiatives gives students greater and closer feelings of their environment and invites them to protect it;

(4) Student-teacher and student-school relations become much stronger due to the fact that such educational initiatives increase the opportunity of participation and teamwork of both students and teachers. In other words, the students' self-esteem and attitudes towards their teachers and school increase remarkably;

(5) The implementation of such initiatives leads to change in the students' way of thinking and improvement of their skills and creativity.

The above aspects combined lead to the creation of an educational environment inside the school and improve the chances of success in the learning process.

The Educational Initiative Effect on Parents

Along the advancement in science and the modern discoveries, most parents strive to provide their children with good education and knowledge in modern science in order to make them capable to accompany such advancements and plan a better future for themselves. Therefore, parents are diligent to find the appropriate route for their children that keep them updated with the latest advancements through different courses in educational and social frameworks.

With respect to this project about the solar village in school, the initiative gave parents the opportunity to know the activities that their children carry out at school, because they were requested to help the children in getting some data for the project.

The Educational Initiative Effect on School Teachers

The plan and implementation of the initiative led to broader knowledge and skills among teachers in developing different educational and learning activities. The implementation of the solar village initiative gave the teachers a great opportunity to gain new information relevant to the subject through their active participations in the project. Many of them showed a great deal of creativities and responsibilities in the execution of the project.

The experience of selecting learning materials, planning activities and executing the project's experiments provided the teachers with deep comprehension of different learning procedures and methods. It made it possible for the teachers to carry out several activities in the subject, which gave them the feeling of independence and self-confidence. They also began to use more methods of teaching, improved their ability to work in teams and became more active in school. The execution of the project led to great cooperation, improved relations between teachers and students and made the teaching process more interesting, which led to improving the learning skills among students, such as planning and execution of research, doing other assignments and the development of the ability to "search and discover" among students in order to understand and become more aware of the environmental phenomena.

During the project, the participating teachers showed a great cooperation in planning the initiative, giving

continuous feedback, reaching conclusions, mutual respect and assistance, teamwork and responsibility towards making the initiative successful.

The teamwork of the participating teachers affected the other faculty members and created a more positive and vital work environment. This led all teachers to adopt new and more effective thoughts and teaching methods.

The execution of the initiative increased the community appreciation of the school and its values in the eyes of parents and Ministry of Education.

Goals of the Project

Short-Term Goals

The short-term goals are as follows:

(1) To provide the students with knowledge about the sun and solar energy from the scientific (biology, chemistry and physics) and technological perspectives;

(2) To inform students about the initial idea of energy utilization and the discovery of energy;

(3) To teach students about the different expressions relevant to solar energy, such as space, sun, atmosphere, solar cells, heat and electricity;

(4) To explain to students the action taking place in the equipments, the changes in the components and its effect on the rest of the factors in the solar village;

(5) To train students to analyze the results and impact of the above stages on the environment and human life;

(6) To enable students to observe and find the use of petroleum energy, its danger on the environment and its effect on the country's economy;

(7) To assist students to develop positive feelings and value for solar energy and its significance and use. This leads to students' greater awareness of the environment and its protection;

(8) To allow students to participate in promoting and making use of solar energy by developing curiosity for the subject, interest to study it in future, knowledge of the new legislations relevant to solar energy and the entities concerned about developing this program.

Long-Term Goals

(1) To create sensitivity, understanding and awareness among students toward solar energy. This is expressed in protecting and promoting healthy environment locally and globally, and wise use of environmental resources;

(2) To motivate students with new relevant subjects in order to develop curiosity and interest among them to study the solar energy in future;

(3) To promote responsibility and concern among students towards the different energy sources, particularly the solar energy as an alternative source and introduce different ways of conserving and preserving energy.

Research in the Educational Initiative

The research question: What is the effect of the educational initiative "solar village" on students, parents and teachers?

The research objective is to examine the educational, social and scientific impact of the initiative on students, parents and teachers.

Research Hypotheses

The research hypotheses are as follows:

Parents' questionnaire. Parents' questionnaires are as follows:

(1) Parents will show interest and support for the project;

(2) The project will have a positive educational impact on students;

(3) Parents will follow up the project consistently through their children;

(4) Parents will support the participation of their children in similar projects in future;

(5) There is no clear picture of the solar village initiative among parents;

(6) Parents will not come to school in order to observe and follow up the project;

(7) The project implementation will promote thinking, curiosity and creativity skills among students;

(8) Parents will support the project financially and participate in the search for information sources relevant to the project.

Students' questionnaire. Students' questionnaires are as follows:

(1) There is no relation between the thing that students learn in the project and daily life;

(2) The project will create positive change in the students' ways of thinking;

(3) The project will improve the creative ability of students.

Teachers' questionnaire. Teachers' questionnaires are as follows:

(1) Teachers will support the integration of the solar energy project in the school curriculum;

(2) Teachers will consider the project promoting to the students' abilities and skills;

(3) Teachers will consider the project enriching for them and their students with relevant information to solar energy;

(4) Teachers will not express readiness to participate in educational projects.

Methodology. Three Arab schools in three different villages were selected for the study. In each school, the target population included the sixth graders (N = 210), their parents (N = 172) and the schoolteachers (N = 45). Three types of questionnaires were prepared for this purpose and were distributed to the three above-mentioned groups. The response rate among parents was quite high reaching 81.9%, and 100% among teachers and pupils in grade six.

Data Analysis

To clarify the data representation, we present both the table and the corresponding chart for each questioner.

Students' Questionnaire

The questions were classified into three categories: scientific, socio-educational and administrative-executive (see Tables 1, 2 and 3, and Figures 5, 6 and 7).

Table 1

Scientific Questions

Questions relevant to scientific factor.
1. During our work in the project, we depended on scientific references relevant to solar energy.
2. The concepts and materials I used in the project were difficult.
3. The project added to my knowledge that it is possible to depend on the sun as an energy source.
4. This project led me to understand the significance of the sun in our daily life.
The scientific factor Mean = 1.673 is closer to 2 (Agree) and SD (Standard Deviation) = 0.505.

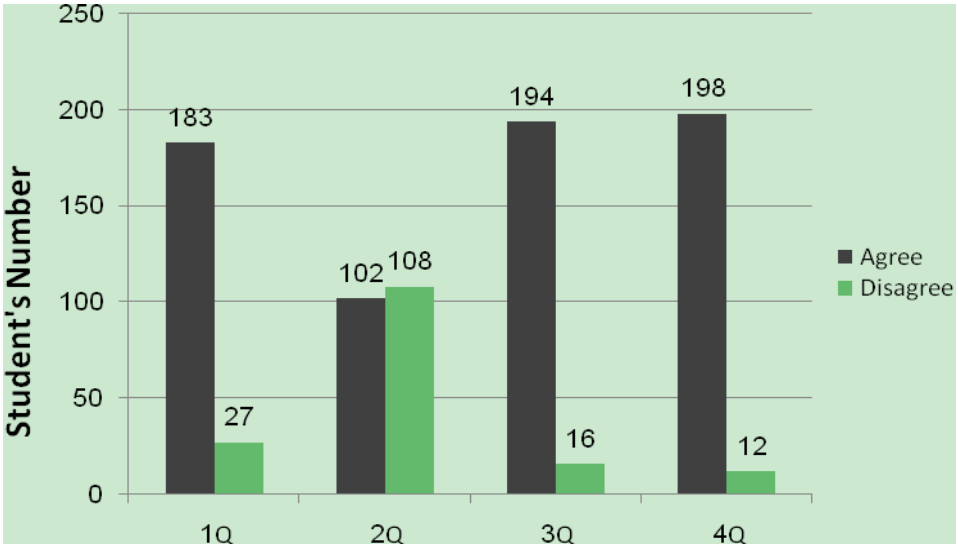

Figure 5. Students' responses to scientific questions.

Table 2

Socio-Educational Questions

Questions relevant to socio-educational factor.
1. The opportunity to participate in the project was open for all students.
2. Carrying out such projects made me interested and strengthened my creative ability.
3. I see it necessary to transform the solar energy initiative into a real one in my hometown.
4. The project made a change in my way of thinking.
5. There is a relation between the things I learned in the project and the daily life.
The socio-educational factor Mean = 1.762 is closer to 2 (Agree) and *SD* = 0.606.

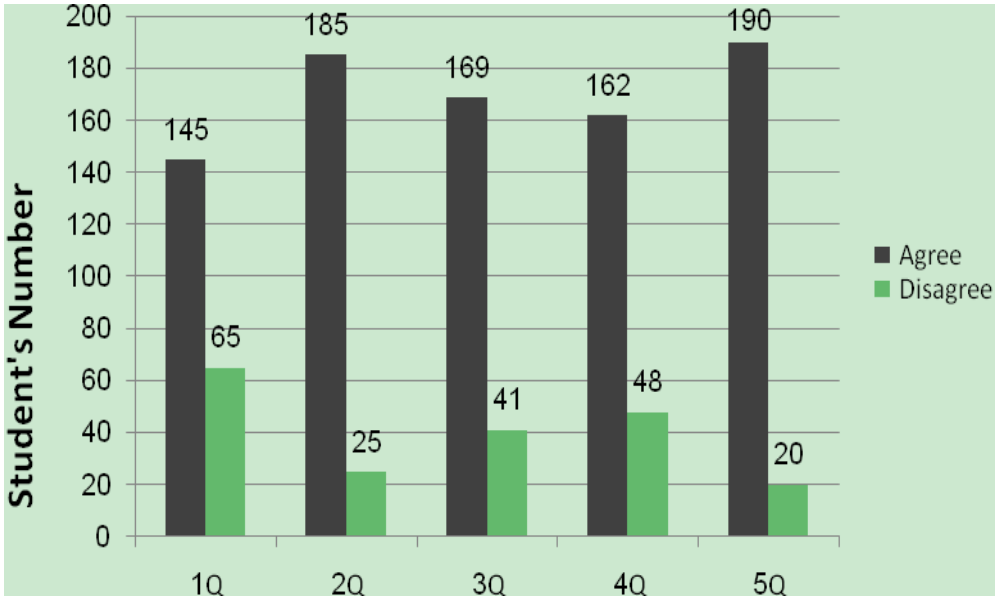

Figure 6. Students' responses to socio-educational questions.

Table 3

Administrative-Executive Questions

Questions relevant to administrative-executive factor.
1. The work principle of the project was clear to me.
2. The work in the project was organized.
3. Planning and preparation for the project were clear.
4. In my opinion, the general benefit of the project was positive.
The administrative-executive factor Mean = 1.484 and *SD* = 0.496. The general Mean = 1.649 is closer to 2 (Agree) and *SD* = 0.455.

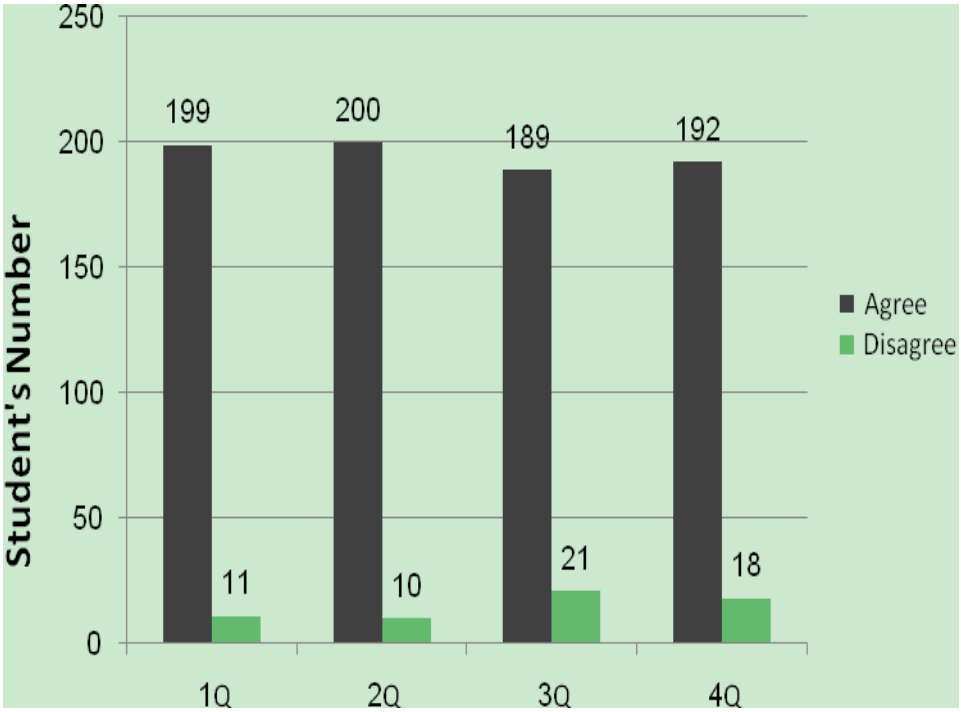

Figure 7. Students' responses to administrative-executive questions.

Teachers' Questionnaire

The questions were classified into three types: The factors related to curriculum and learning tools, the factors related to interest in the project and the scientific-educational factors (see Tables 4, 5 and 6, and Figures 8, 9 and 10).

Table 4

The Factors Related to Curriculum and Learning Tools

Questions related to curriculum and learning tools
1. I support relating the learning materials with real life.
2. The needed materials and equipment for the project were made available without any difficulty.
3. The project contributed tremendously in the application of learning materials.
The factors related to curriculum and learning tools Mean = 1.807 is closer to 2 (Agree) and *SD* = 0.411.

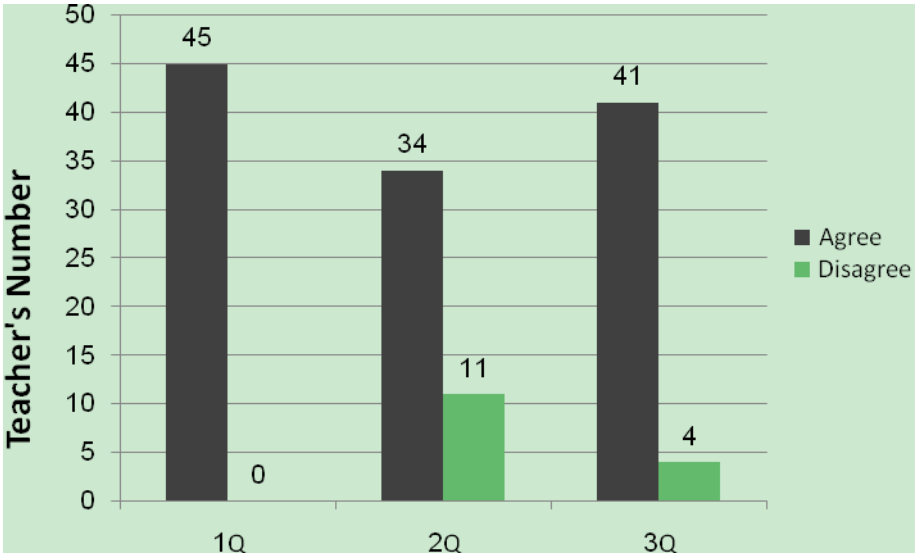

Figure 8. Teachers' responses to curriculum and learning tools questions.

Table 5

The Factors Related to Interest in the Project

Questions related to interest in the project.
1. I am ready to participate in educational projects.
2. My general evaluation of the initiative is positive.
3. I am willing to participate in educational projects all the time.
The factors related to interest in the project Mean = 1.762 is closer to 2 (Agree) and *SD* = 0.606.

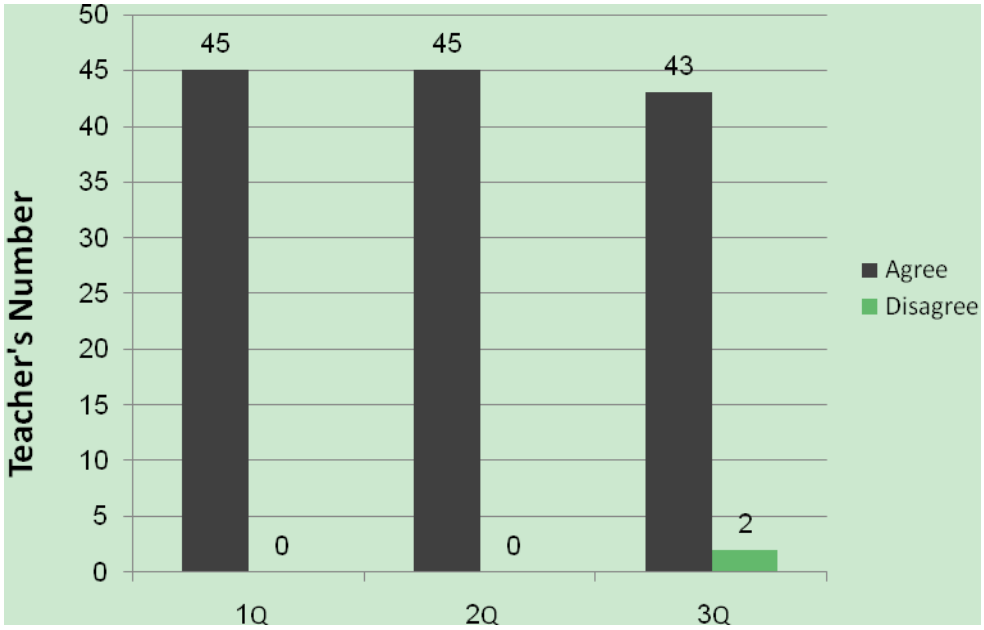

Figure 9. Teachers' responses to interest in the project questions.

Table 6

The Scientific-Educational Factors

Questions related to scientific–educational factor.
1. The solar energy project created a change in the students' ways of thinking.
2. The students' responses and interests in the project were excellent.
3. This kind of project strengthens the skills and promotes creative abilities among students.
4. This project is beneficial for students.
5. The project goals were accepted widely at school.
6. The project gave sufficient information about the use of solar energy as an alternative for burning fuel.
The scientific-educational factor Mean = 1.663 is closer to 2 (Agree) and *SD* = 0.428. The general Mean = 1.633 is closer to 2 (Agree) and *SD* = 0.326.

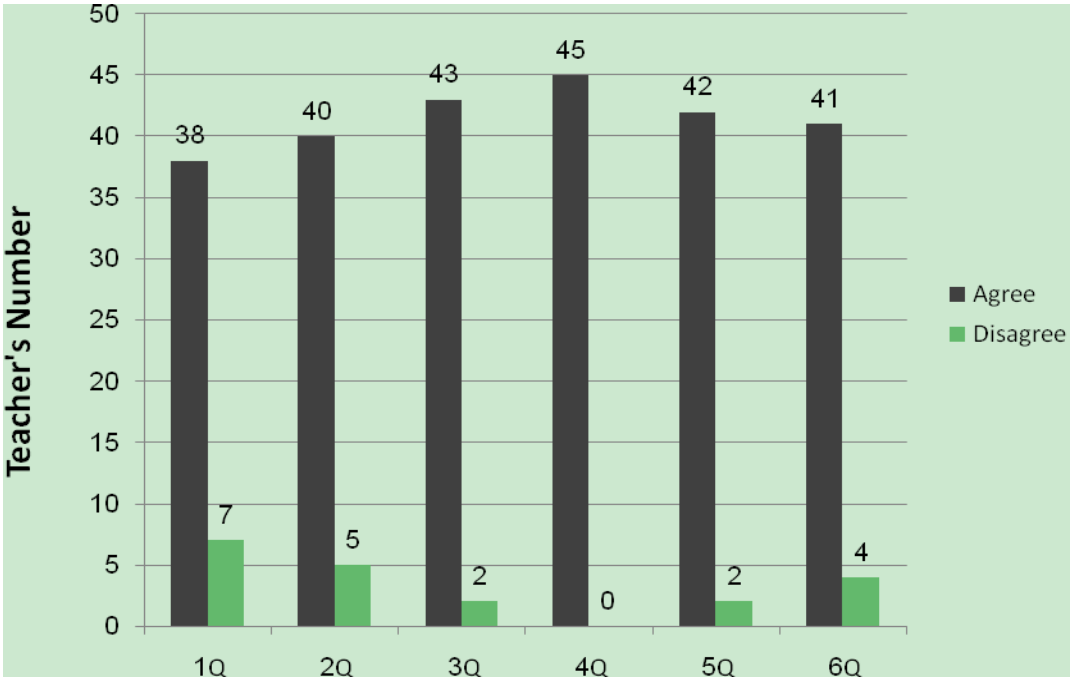

Figure 10. Teachers' responses to scientific-educational questions.

Parents' Questionnaire

The questions were classified into two categories: concern and intervention in their children's affairs and curiosity and interest in scientific issues (see Tables 7 and 8, and Figures 11 and 12).

Table 7

Concern and Intervention in Their Children's Affairs

Questions related to concern and intervention in the children's affairs.
1. I support my child's participation in the project to make him successful.
2. I noticed that my child follow the project with lots of interest.
3. I see this project as a positive step toward the promotion of thinking and creativity among children.
4. I see that the project had a positive effect on my child.
The factors related to concern and intervention in the children's affairs. Mean = 1.546 is closer to 2 (Agree) and *SD* = 0.480.

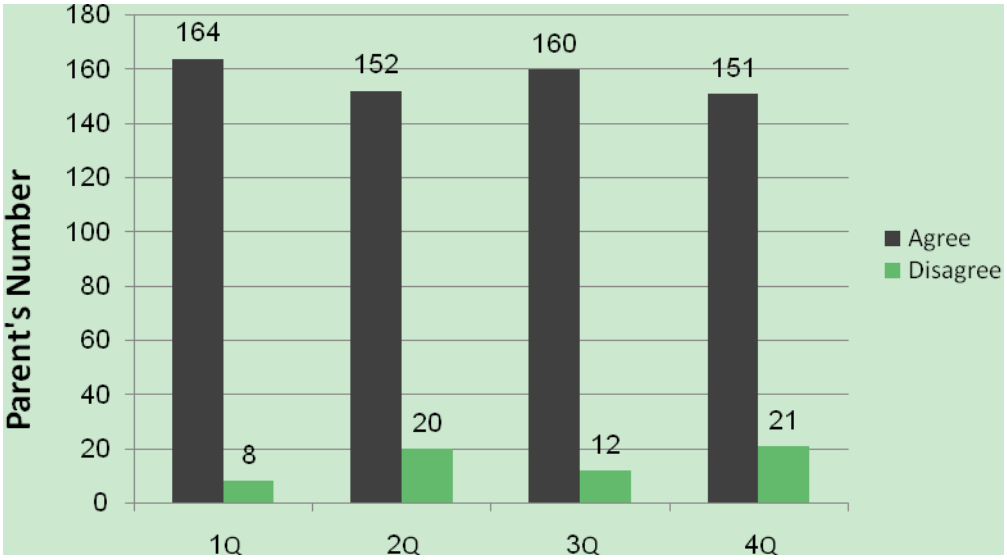

Figure 11. Parents' responses to concern and intervention in their children's affairs questions.

Table 8

Curiosity and Interest in Scientific Issues

Questions related to curiosity and interest in scientific issues.
1. When I heard about the solar village, I became very interested in the project.
2. I took part in the search for references relevant to the sun and its significance as an energy source.
3. I noticed that my children follow the project with lots of interest.
4. My child's participation in this project made me realize the significance of the sun as a pure and complete source of energy.
5. If the project is implemented in my hometown, I will be the first to join it.
6. My general evaluation of the project's benefit is positive.
Curiosity and interest in scientific issues Mean= 1.758 is closer to 2 (Agree) and *SD* = 0.549. The general Mean = 1.674 is closer to 2 (Agree) and *SD* = 0.454.

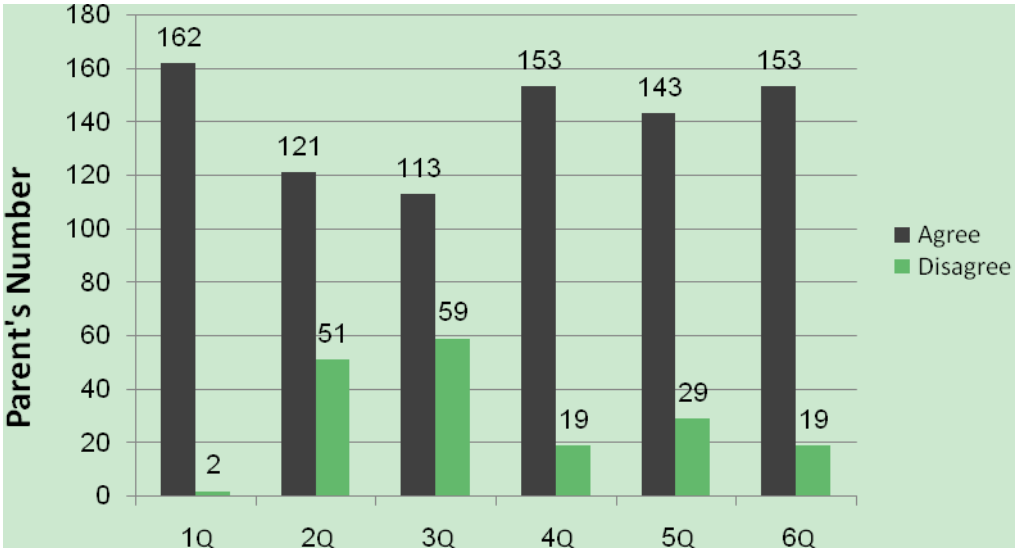

Figure 12. Parents' responses to curiosity and interest in scientific issues questions.

Discussion

Analysis and Discussion of Results Relevant to Students

The study results support the hypothesis that the solar village project will stimulate the students' interests socially and educationally. Therefore, similar projects are recommended.

The project showed a positive effect on the promotion of thinking and creativity among students. The study findings support the hypothesis, 77% of the students admitted that the project's impact was positive, and somehow it changed their ways of thinking and enhanced their creativities.

The findings showed that the principle and plan of the project were clear according to 90% of the students' responses. This stresses that there are no obstacles to justify fears and hesitations to implement such a project.

Ninety percent of the students pointed to the strong relation between the acquired topics during the project and their understanding of the sun's importance on one side, and the practice in their daily life on the other. This reflects the project's great benefit to the students by making them capable of relating the material they learn to the events of their daily life. They also become more capable of sensing and imagining new material and applying it in their daily activities.

A great majority (80.5%) of the students showed support to the conversion of the solar village initiative to reality in their hometowns.

Analysis and Discussion of Results Relevant to Teachers

With respect to the findings relevant to the impact of the solar village project on teachers, we will discuss the following points:

(1) The study findings support the hypothesis that the initiative contributes to a great extent in application of the learned material to the daily life. Therefore, we must call the teachers' attention to emphasize the application of the learning material to the daily activities. Such application reinforces the students' understanding and appreciation of scientific topics, which helps in achieving the learning goals;

(2) The vast majority of teachers (95.6%) admitted that the initiative has promoted the students' capabilities and creativity and highlighted the educational and social aspects of the children's readiness to participate with other mates and teachers in learning projects and discuss and exchange ideas with others. The initiative gave the children the opportunity to use their skills that are, in most cases, undetected or neglected;

(3) The vast majority of teachers (93.3%) said that the project's objectives were widely accepted at school, and all teachers (100%) agreed that the initiative's impact was positive. These results assert that the solar village initiative was widely accepted by students, parents and teachers. These groups support such initiative because of great educational impact and its effect in increasing the students' moral and in promoting their thinking and creativity. Socially, the initiative offers everyone the opportunity to participate in the activity and become acquainted with issues relevant to our environment and have a positive effect on our daily life. From a learning aspect, it increases the students' knowledge about our surrounding, especially the dependence on the sun as a source of energy in future;

(4) The study results show that almost all the teachers (95.4%) are willing to participate in educational projects inside the school. This indicates the positive impact of the solar village project on the schools that carry out this and similar projects. Teachers showed appreciation for projects that benefit the children, teachers and families from the educational, social and humanitarian aspects.

Analysis and Discussion of Results Relevant to Parents

With respect to the findings relevant to the project's impact on parents, we will discuss the following points:

(1) The majority of parents (95.3%) are supportive of projects that give their children the opportunity to participate, because they think that such projects like the solar energy village are very important to their children;

(2) The results show that the majority of parents followed the progress of the project by visiting the school and offering help in the project. Eighty-eight point four percent of the parents observed their children's involvements with great interests in the project;

(3) The majority of parents (87.8%) see a positive impact of the project and expressed willingness to be among the first ones to apply the project in actual life;

(4) A great majority of parents (95.0%) think that the project promotes creativity among their children, because it opens the way for them to show their creative ability and it promotes their thinking abilities and improve their chances of success in their education in future.

Conclusions

In this study, we examined the views of the students, parents and teachers and their readiness to support and participate in such educational initiative. The following points may summarize the findings:

(1) The three groups assert the positive impact of the project educationally and socially;

(2) The execution of educational initiatives inside the school promotes creativity and thinking ability among students;

(3) Parents showed a great support for the project, because they see the positive impact of the project on their children's learning abilities;

(4) Teachers considered this initiative quite important due to the students' interactions and interests;

(5) Such projects increase the mutual relations and interactions between students and their teachers, which leads to the success of the school;

(6) The execution of such educational projects provides the students with basic concepts and terms from their own surrounding.

It also improves the learning skills of the students, such as reading plans, executing research and writing reports.

Recommendations

Based on the findings of this study, we recommend the followings:

(1) To focus on carrying out similar educational initiatives;

(2) To encourage parents to follow-up the execution of educational projects, because it constitutes a positive motive for their children to actively participate in the projects;

(3) Teachers must make sure that learning materials are formed in an applicative way with the students' participation;

(4) To call the attention of the concerned parties, such as school faculties, local authorities and parent committees to finance educational projects that yield positive outcomes from the educational and learning aspects.

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