

RENEWABLE ENGINEERING FOR MULTIDISCIPLINARY FEMALE ENGINEERING'S IN THE UAE

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Contents

- ▣ Introduction
- ▣ STEPS Course Definition
- ▣ STEPS Course Objectives
- ▣ STEPS Project
- ▣ Solar Energy
- ▣ Project Description
- ▣ Work Sample
- ▣ Project Outcome
- ▣ Course Outcome
- ▣ Renewable Energy
- ▣ Implementation of Renewable Energy
- ▣ Conclusion
- ▣ Questions

Introduction

- ❑ PI (Petroleum Institute), is an English language medium engineering college, where English is a second language for all of the students.
- ❑ The PI support the students learning by offering them a foundation program of maximum two years to ensure their basic Sciences, Mathematics and English skills are of a suitable level to undertake their engineering degree.
- ❑ At PI, it is highly recognized that it is important to ensure that the students have a continual opportunity to improve and further develop their communication skills, study skills [3] and understanding of technical concepts.
- ❑ To enable this development, the core programs offer a series of courses called Strategies for Team-based Engineering Problem Solving (STEPS).
- ❑ The importance of these courses is to enable our future engineers to contribute in solving the increasing complex problems facing our society, recognizing the complexities of global and social issues and responding with solutions they develop

STEPS Course Definition

The STEPS course is a team-based engineering design with emphasis on multidiscipline oriented client-linked problems. Oral and written professional technical communications as well as teamwork and project management are further developed.

STEPS Course Objectives

- ▣ Demonstrate competency in applying the steps of the engineering design process to solve open-ended problems.
- ▣ Demonstrate ability to present design solutions in oral presentation and written reports.
- ▣ Practice understanding principles of project management.
- ▣ Demonstrate skills in effective teamwork.
- ▣ Demonstrate ability to gather, analyze, and interpret data.
- ▣ Demonstrate ability to self learn, research and use information
- ▣ Gain awareness of ethical, social, global and economical influence of engineering design

STEPS Project

- ❑ The STEPS multidisciplinary project introduces students to authentic engineering problem solving in the 21st century, with special emphasis on environmental and humanitarian issues facing engineers in both our local and broader global communities.
- ❑ Students practice the process of solving an open-ended engineering problem while working in teams.
- ❑ Authentic professional interaction with community specialists serves to give students a taste of the scope of “real world” engineering.
- ❑ Standards for deliverables in technical writing, oral presentations, graphical demonstration, and demonstration of technical knowledge are “professional.”
- ❑ The responsibilities of professional global engineers is stressed, including stewardship of our planet and its resources; health, safety, and welfare of its inhabitants; engineering ethics, and intercultural communication.

Solar Energy

- ❑ The UAE seems a diligent contender in the pursuit of renewable energy and is a forerunner due to the climatic and geographic conditions which offers greater amount of sunlight averaging at about eight hours per day in winter and reaches as high as eleven hours in summer.
- ❑ Forecasts suggest that by 2050, up to half of the UAE's required energy will come from renewable technologies.
- ❑ Engineering students and faculty at PI have always wanted to contribute toward a cleaner and safer environment therefore they have always shown a active interest in sustainability
- ❑ The STEPS faculty came up with a project that will enhance the role of our engineers in the application of solar energy in the region, hence keep it more sustainable for the generations to come.
- ❑ The STEPS course is required for all engineering fields, this project offers a full range of ideas and implementations to a specific renewable energy problem that covers all disciplines.

Project Description

"The effect of wind borne particles from a desert environment may be classified according to its lasting disturbance, and therefore we are to deal with effects of disturbances with temporary (reversible) and permanent (irreversible) nature. Temporary instabilities include the likes of dust and/or sand dispositions on the PV array surface, which in turn lessens the sun's impact on the cells leading to unequal current distributions. These will further continue to lower levels of power output. Also, in some desert environments, the country experiences scattered rainfalls which implies that instead of periodic downpours of water, which may clean the PV arrays off the dirt layers, these rainfalls result in a caked surface clouding the surface of the PV array. This is of course detrimental to the power produced by the PV array as it covers the panel's surface completely. Permanent disturbances revolve around damages incurred, such as heavy particles in the frequent sand storms, which chip away the sensitive glass surface leaving a jagged and inconsistent coating. As a result when incident light rays strike the surface, they will undergo internal reflection with the light scattering within the surface. This loss will lower the efficiency and may be corrected only if the panel as a whole is replaced. No methods of cleaning or tilting will solve the loss incurred. The problem however stems from the use of these sources of energy in a climatic condition such as that of the UAE which experiences continuous high temperatures alongside the occasional strong winds resulting in perpetual sandstorms, and as such these factors must be fully investigated when realizing the full feasibility of their use within such a physically harsh surrounding".

Work Sample

The Mojo Cleaner

A cleaning mechanism for PV panels
A project for MASDAR



The Carpe Diem team worked in a project for MASDAR. The main objective of the project is to reduce the maintenance and costs on the panels using solar energy. MASDAR's goal is to rely entirely on solar power as their renewable energy source. The main challenge presented by MASDAR was to design a mechanism that is able to clean the panels using solar energy.

1- Trigger Subsystem
- Complete subunit

2- Mechanical Subsystem
- Motor
- Spring and Gears
- Rack and Pinion
- Pulley system

3- Cleaning Subsystem
- Brush
- Cleaning pad
- Spring

As soon as sunlight will be detected by the sensor, the motor will start the mechanical system and the rotation motion of several gears will make the tarp cover move. This will be done by the pulley system that will be being moved upwards. As the pulley will start moving the tarp will start moving over a wheel system. The rotation of the wheel will lead to hold the tarp and start cleaning the panel. The rotation of the motor will be stopped by the sensor.

Part	Project Objective	Important Feature	Function
1	Tarp cover	Side	Helps cover the sun, rain, snow and protect the panels
2	DC Motor	Automatically Feeds	Controlled by the solar panels
3	Pulley system	Automated	As the motor starts pulling the tarp cover up and down
4	Spring steel	Stiff and automatically Feeds	Control the tarp
5	Rotating wheel	Responsible and automatically Feeds	Responsible for holding and cleaning the cover
6	Connecting rod	Responsible and automatically Feeds	Transfers motion from the connecting rod
7	Wheel	Responsible and Feeds	Transfers motion from the connecting rod
8	Motor	Stiff and Feeds	Provides motion to the motor





Carpe Diem

Team members: Marwan Al Hamdi, Raed Al Zoubi, Sara Al Anwar, Gary Al Hossni

Project Outcome



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Course Outcome

- ▣ Success in building a prototype
- ▣ Design suitable for 6 months testing
- ▣ Excellent marketing skills
- ▣ Problems faced:-
 - Lack of technical knowledge
 - Inexperienced in practical design
 - Unavailability of materials

Renewable Energy

- ▣ This study has concentrated on solar energy because it is the most readily available in the UAE but there are many other types of renewable energy that are available worldwide such as biomass, wind, hydro and geothermal.
- ▣ In this region, hydro and geothermal are not feasible solutions because of the environmental structure and location of the UAE, therefore wind and biomass are the only other suitable renewable energies for implementation in this country.
- ▣ Although wind is a more noticeable solution for electricity generation in this region biomass should not be neglected as it can support the other renewable energy options.

Implementation of Renewable Energy

- ▣ The UAE is predominately an oil and gas producing nation and as the PI is sponsored by ADNOC (Abu Dhabi National Oil Company) and its OPCOs (Operating Companies), students projects are designed to solve issues that these companies face.
- ▣ While ADNOC is an oil and gas producing company, it has a great interest in supporting this traditional energy source with renewable energy.
- ▣ Biomass and wind could be good alternatives for renewable energy projects being undertaken on onshore and offshore islands and projects and research are developed accordingly.

Conclusion

- ❑ Preparing future engineers to understand and implement the global and societal implications of the products and systems they design is a priority for the engineering community as a whole and PI in particular.
- ❑ This course has a great impact on teaching our students honesty and integrity on par with technical competence as an essential characteristic of engineers prior to their introduction to the engineering ethics.
- ❑ The multidisciplinary freshman female students at PI have benefited greatly from this experience.
- ❑ They have developed their ability for critical thinking, project management, team working, time management, and most of all their engineering skills.
- ❑ While this experience has shed light on educating female engineering students with no technical background in the concepts of solar energy and its components, it can definitely be extended to other renewable sources.

QUESTIONS ?

Thank you for your attention

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Renewable Engineering for Multidisciplinary Female Engineering's in the UAE

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Abstract

All engineering programs at the Petroleum Institute (PI) in the United Arab Emirates (UAE) require students to undertake the STEPS course at the freshman level. This course focuses on solving an engineering problem in a multidisciplinary team based environment. This paper presents the effect on the female students when offering a solar energy project at the freshman level where students lack technical engineering knowledge. This project aims to spread awareness on sustainability and global warming issues in addition to encouraging students to play an important role in providing a cleaner and safer environment for the new generations. In addition, this course enables the students to develop their skills in the design process. This solar energy project has proven to be a great success in developing the female students' interest and knowledge not only in environmental issues but also in their technical fields. Although this project concentrates on solar renewable energy concept, similar experience can be carried on to expose undergraduate students to other renewable sources such as biomass, hydro and wind. This institution is currently developing undergraduate research and projects that focuses on the topics mentioned to enhance the curriculum.

Introduction

The Petroleum Institute (PI) in Abu Dhabi, UAE was founded in 2000 under the direction of H.H. Sheikh Khalifa bin Zayed Al-Nahyan. It is currently a purely engineering university with four disciplines of engineering (Chemical, Electrical, Mechanical, and Petroleum) directly related to the oil and gas industry. The Petroleum Institute is financed and governed by Abu Dhabi National Oil Company (ADNOC) and its international partners (Shell, British Petroleum, Total, and Japan Oil Development Company). The PI was developed to provide the UAE and its oil and gas industry with engineers educated and trained to the highest standards. In June 2006, it graduated its first class of male students which consisted of forty-four graduates and has currently about eight hundred male students. Like many Universities in the region the PI is split into female and male campuses. In fall 2006, the institution had its first intake of female students.

Although the institute is split by gender, the UAE has been highlighted by the United Nations as amongst the most developed nation in educating females [1]. It also discusses the vision and influence of Sheikha Fatima bint Mubarak and states that educating a man educates one individual but educating a woman educates a family. UAE women are encouraged to become highly educated and there is no limits to their choice of careers therefore they are capable of reaching high levels in industry and academia [1].

PI, is an English language medium engineering college [2], where English is a second language for all of the students. The PI support the students learning by offering them a foundation

program of maximum two years to ensure their basic Sciences, Mathematics and English skills are of a suitable level to undertake their engineering degree. At PI, it is highly recognized that it is important to ensure that the students have a continual opportunity to improve and further develop their communication skills, study skills [3] and understanding of technical concepts [4]. To enable this development, the core programs offer a series of courses called Strategies for Team-based Engineering Problem Solving (STEPS). These courses are taught by engineering professors of many disciplines. The importance of these courses is to enable our future engineers to contribute in solving the increasing complex problems facing our society, recognizing the complexities of global and social issues and responding with solutions they develop. Such work is widely acknowledged in the engineering education community [5-11]. The ABET Criteria for Accrediting Engineering Programs incorporate contextual issues in two of the eleven learning outcomes expected to be achieved by engineering graduates. Among ABET's technical and professional learning outcome are both "an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability" and "the broad education necessary to understand the impact of engineering solutions in the global, economic, environmental, and social contexts" [8].

STEPS Course

The STEPS course is a team-based engineering design with emphasis on multidiscipline oriented client-linked problems. Oral and written professional technical communications as well as teamwork and project management are further developed. There is an increased focus on the application of multidisciplinary engineering practices and principles to solve open-ended problems. Human, social and global aspects of engineering design and engineering ethics are also discussed. The objectives of the courses are to:

- Demonstrate competency in applying the steps of the engineering design process to solve open-ended problems.
- Demonstrate ability to present design solutions in oral presentation and written reports.
- Practice understanding principles of project management.
- Demonstrate skills in effective teamwork.
- Demonstrate ability to gather, analyze, and interpret data.
- Demonstrate ability to self learn, research and use information
- Gain awareness of ethical, social, global and economical influence of engineering design.

STEPS Project

The STEPS multidisciplinary project introduces students to authentic engineering problem solving in the 21st century, with special emphasis on environmental and humanitarian issues facing engineers in both our local and broader global communities. Students practice the process of solving an open-ended engineering problem while working in teams. However, projects will involve extensive research and will require project conclusions to be based on sound and verifiable evidence. Authentic professional interaction with community specialists serves to give students a taste of the scope of "real world" engineering. Standards for deliverables in technical writing, oral presentations, graphical demonstration, and demonstration of technical knowledge are "professional." The responsibilities of professional global engineers is stressed, including stewardship of our planet and its resources; health, safety, and welfare of its inhabitants; engineering ethics, and intercultural communication. One of the issues related to a

multidisciplinary team project lies in its difficulty to come up with a project that is directly related to all disciplines. Another issue with the STEPS course is the lack of engineering experience, so although the project should be engineering based, technical content should be limited.

Solar Energy

The UAE seems a diligent contender in the pursuit of renewable energy and is a forerunner due to the climatic and geographic conditions which offers greater amount of sunlight averaging at about eight hours per day in winter and reaches as high as eleven hours in summer. Although the UAE is a large producer of oil and gas, Saud Al-Humaidan, the ministry's assistant undersecretary for technical affairs stated "There is no doubt we have good oil reserves, but one can't be sure how long they will last. Renewable energy should be seen, not only as an alternative energy, but also as a cleaner and better option" [13]. Forecasts suggest that by 2050, up to half of the UAE's required energy will come from renewable technologies. Solar energy, the cleanest source in environmental terms, is likely to form a large percentage in application in the UAE. Engineering students and faculty at PI have always wanted to contribute toward a cleaner and safer environment therefore they have always shown a active interest in sustainability. As sustainability is defined as looking at the issues and problems facing our world with a new perspective, sustainable engineers must address these challenges by adapting existing technologies and developing new ones. Thus, students do not only require technical knowledge but also a background to social sciences in order to leave the world's cleaner than they found it. Based on all the above mentioned, the STEPS faculty came up with a project that will enhance the role of our engineers in the application of solar energy in the region, hence keep it more sustainable for the generations to come. Since the STEPS course is required for all engineering fields, this project offers a full range of ideas and implementations to a specific renewable energy problem that covers all disciplines.

Project Description

The following project description gives the students the required information. The project enables students of multidisciplinary engineering fields to participate together. The project statement is as follows:

“The effect of wind borne particles from a desert environment may be classified according to its lasting disturbance, and therefore we are to deal with effects of disturbances with temporary (reversible) and permanent (irreversible) nature. Temporary instabilities include the likes of dust and/or sand dispositions on the PV array surface, which in turn lessens the sun's impact on the cells leading to unequal current distributions. These will further continue to lower levels of power output. Also, in some desert environments, the country experiences scattered rainfalls which implies that instead of periodic downpours of water, which may clean the PV arrays off the dirt layers, these rainfalls result in a caked surface clouding the surface of the PV array. This is of course detrimental to the power produced by the PV array as it covers the panel's surface completely. Permanent disturbances revolve around damages incurred, such as heavy particles in the frequent sand storms, which chip away the sensitive glass surface leaving a jagged and inconsistent coating. As a result when incident light rays strike the surface, they will undergo internal reflection with the light scattering within the surface. This loss will lower the efficiency

and may be corrected only if the panel as a whole is replaced [14]. No methods of cleaning or tilting will solve the loss incurred.

The problem however stems from the use of these sources of energy in a climatic condition such as that of the UAE which experiences continuous high temperatures alongside the occasional strong winds resulting in perpetual sandstorms, and as such these factors must be fully investigated when realizing the full feasibility of their use within such a physically harsh surrounding [15]”.

Implementation for other Renewable Energy Sources

This study has concentrated on solar energy because it is the most readily available in the UAE but there are many other types of renewable energy that are available worldwide such as biomass, wind, hydro and geothermal. In this region, hydro and geothermal are not feasible solutions because of the environmental structure and location of the UAE, therefore wind and biomass are the only other suitable renewable energies for implementation in this country. Since wind is caused by the uneven heating, wind turbines can capture the solar energy stored in wind and convert it to electricity. It produces no air or water pollution as well as no toxic or hazardous substances. Although wind is a more noticeable solution for electricity generation in this region biomass should not be neglected as it can support the other renewable energy options. In a process called photosynthesis, plants capture sunlight and transform it into chemical energy which may be converted into electricity heat or liquid fuels. Organic resources that are used to produce energy using this process are called biomass. The UAE is predominately an oil and gas producing nation and as the PI is sponsored by ADNOC (Abu Dhabi National Oil Company) and its OPCOs (Operating Companies), students projects are designed to solve issues that these companies face. While ADNOC is an oil and gas producing company, it has a great interest in supporting this traditional energy source with renewable energy. Therefore biomass and wind could be good alternatives for renewable energy projects being undertaken on onshore and offshore islands and projects and research are developed accordingly.

Conclusion

Preparing future engineers to understand and implement the global and societal implications of the products and systems they design is a priority for the engineering community as a whole and PI in particular. Many of the engineering programs and courses teach students about global and societal issues through design experiences. This is accomplished by stressing on the characteristics of the design process which influences the quality of the final solution. Such emphasis was stressed on in the implementation of the STEPS course offered to freshman female students while designing the final product required by the client. This course also has a great impact on teaching our students honesty and integrity on par with technical competence as an essential characteristic of engineers prior to their introduction to the engineering ethics.

The multidisciplinary freshman female students at PI have benefited greatly from this experience. They have developed their ability for critical thinking, project management, team working, time management, and most of all their engineering skills. In addition to that the course has fulfilled its objective by spreading awareness on issues related to society and environment the world is facing.

While this experience has shed light on educating female engineering students with no technical background in the concepts of solar energy and its components, it can definitely be extended to other renewable sources. This type of projects is not gender limited and it has proven to enhance the curriculum by developing the students' technical knowledge and design abilities.

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