

Engineering Recruitment Program

Engineering Summer Programs

Report Summaries

FY 2010

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Project Selection Process

The Engineering Recruitment Program (ERP), Engineering Summer Program (ESP), was established by the 80th Texas Legislature through passage of House Bill 2978, codified as Texas Education Code 61.791. The purpose of the program is to provide grants to general (public) academic teaching institution and independent institutions that offer an engineering degree program to implement a one-week summer program for middle and high school students, so that these students are exposed to math, science, and engineering concepts they can expect to encounter in an engineering degree program. Independent institutions were allowed to participate through House Bill 2425 of 81(R), June 2009.

Selection Step 1: The legislature appropriated \$1 million for each year of the 2010-11 biennium. A state-wide budget reduction of five percent reduced the appropriation by \$100,000 for the biennium. The Coordinating Board (CB) allocated \$500,000 of the annual state appropriation for the summer program portion of the ERP, but used only \$400,000.

Selection Step 2: The CB issued a Request for Applications on January 28, 2009, posted it on its ERP website, and sent email notifications to all eligible institutions. Eligible institutions were all public and independent institutions that have an engineering program.

Selection Step 3: The CB received 23 applications from 34 eligible institutions and set the award amount for each program at \$18,000.

Selection Step 4: Twenty-two applicant institutions finalized a budget and requested a contract.

Selection Step 5: By end of May, 2010, the Coordinating Board executed contracts with the 22 applicant institutions.

Participating Institutions

Baylor University, School of Engineering and Computer Science

Midwestern State University, McCoy School of Engineering

Prairie View A&M University, Department of Electrical and Computer Engineering

St. Mary's University, Department of Computer Engineering

Texas A&M International University, Department of Engineering, Mathematics, and Physics

Texas A&M University, Department of Electrical and Computer Engineering

Texas A&M University at Galveston, Department of University Outreach

Texas A&M University-Commerce, Department of Industrial Engineering

Texas A&M University-Corpus Christi, Department of Industrial Engineering

Texas A&M University-Kingsville, Department of Environmental Engineering

Texas A&M University-Texarkana, Department of Electrical Engineering and Computer Science

Texas State University-San Marcos, Department of Manufacturing Engineering

Texas Tech University, Department of Construction Engineering

The University of Texas at Arlington, College of Engineering

The University of Texas at Austin, Equal Opportunity in Engineering Program

The University of Texas at Brownsville and Texas Southmost College, College of Applied
Technology

The University of Texas at El Paso, Studies and Engineering Education Research

The University of Texas at Tyler, College of Engineering and Computer Science

The University of Texas of the Permian Basin, Department of Continuing Education

The University of Texas-Pan American, Department of Mechanical Engineering

The University of North Texas, Department of Computer Science, and Engineering

West Texas A&M University, Department of Engineering and Computer Science

Engineering Recruitment Program

ERP 2010 Engineering Summer Programs

Participation Statistics

Number of institutions	22 institutions
Number of one-week programs	22 programs
Number of participants	681 students
Average per one-week program	31 students
Median per one-week program	29 students
Smallest one-week program	16 students
Largest one-week program	92 students
Female participation	40%
White participation	39%
African-American participation	15%
Hispanic participation	38%
Other participation (Asian, Native American, unknown)	8%
Number of one-week programs with up to 30 participants	13 programs
Number of one-week programs with 30 to 45 participants	7 programs
Number of one-week programs with more than 45 participants	2 programs
Number of programs with girl-only participation	3 programs
Number of programs that included middle school students	12 programs
Number of residential programs	7 programs
Number of day programs	14 programs
Number of residential/day programs	1 programs

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Baylor University

Renaissance Scholar Program

Project Leader: Dr. Benjamin Kelley and Dr. Adam P. Ecklund, School of Engineering and Computer Science

Type of Program: Residential, mixed gender program for high school students

Program Dates: 6-12 June, 13-19 June, and 20-26 June 2010

Participants: 15 male, 7 female, 6 Hispanic, and 3 African American students

Synopsis:

The students experienced launching trebuchets, testing solar panels, and building and launching rockets. They also looked at theoretical versus actual data in the labs through experiments. The students were exposed to mechanical and electrical engineering, multiple faculty, current undergraduate students as mentors, graduate students, and also met with the Dean of Engineering multiple times to become familiar with the discipline.

A Renaissance Scholar is someone who is conversant across the entire range of human knowledge, from science to philosophy and technology to literature. We considered some issues, of both historical and contemporary interest, viewed these from the perspective of science, technology, literature, philosophy, theology, and even contemporary film.

To complement the readings in the great texts of the world, the students were involved in the design, development, and implementation of two engineering projects. Students had to learn the engineering concepts involved in the construction of a trebuchet. They also learned the engineering and computer science concepts involved in the construction of a labyrinth, both as a physical representation and as a recursive graphical algorithm.

Students had to demonstrate independent learning and the synthesis of ideas. They had to demonstrate integration of concepts in literature, philosophy, engineering, and computer science through design, development, implementation, and presentation.

The ESP coexisted with the university's Honors College and involved students specifically having an interest in engineering. We held the same program over 3 different weeks and limited overall participation to about 25 students per week. Because of this, students interested in engineering and participating in ESP had to attend in three different, consecutive weeks.

The cost of the Honors College program was \$1,400 per student. We recruited 22 engineering students for ESP and provided ESP students with scholarships, lowering the program cost. The grant enabled two students to attend, that otherwise would have had to cancel participation, because of sudden economic difficulties.

Program Content and Activities:

- Student Team Competitions – Building and launching rockets, launching trebuchets, computer animations.
- Project Presentation – Concluding presentations to all faculty involved, deans, parents, family, and friends. Students produced a website showing what they had learned.
- Field Trips – Visited the Mayborn museum and an energy exhibit created by undergraduate electrical engineering students.
- Luncheon discussions – Lunches included industry representatives, deans, faculty, and admission staff.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – A counselor concluded the program with a presentation about the admission process.

Midwestern State University

Midwestern State University Young Engineer Summer (MSU YES) Program

Project Leader: Dr. Sheldon Wang and Dr. Idir Azouz, McCoy School of Engineering

Type of Program: Mixed-gender residential/day combined program for high school students

Program Dates: 21-25 June, 2010

Participants: 17 male, 6 female, 1 Hispanic, and 5 African American students

Synopsis:

Program objectives of Midwestern State University Young Engineer Summer (MSU YES) Program were to enhance participants' interest in engineering as a potential career and to develop analytical skills needed for college-level courses. The majority of the participants were from the Wichita Falls and Dallas areas; however, three students came from the Houston area. This was the first time the program was held.

Participants attended sessions and worked through activities that introduced them to the basic sciences and mathematics necessary for various disciplines of engineering. Students experienced a wind tunnel, learned about automation and control, material science, chemistry, and solid modeling software. They took part in engineering project competitions and went on an industry field trip to Alcoa Howmet's local manufacturing facility.

Eleven Midwestern State University engineering students participated as student assistants. Their dedication made the program a safe, informative, and fun experience for the participants.

Program Content and Activities:

- Student Team Competitions – Three separate mechanical challenges were given for LEGO Robotics based designs. The first mechanical challenge was a drag race, the second a vehicle that could carry the heaviest weight over a short course, and the third was a non-wheeled vehicle. Students also competed in a design challenge to create name blocks, which were cut and personalized for each program participant.
- Project Presentation – Students had to present and explain their methodology to the group, for each of the mechanical challenges. A question and answer format encouraged highlighting the more successful and original solutions to the challenges.
- Field Trips – Participants saw the entire McCoy School of Engineering, particularly the laboratories, and were introduced to the research and studies conducted in each.
- Industry Site Visits – Students undertook a site visit to the Alcoa Howmet plant. They learned about the many processes involved in preparing and casting turbine blades used in both military and civilian jet engines.
- Luncheon discussions – Engineers of the Alcoa Howmet plant engaged students in discussion during the site visit.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Staff of the Midwestern State University admissions office explained the application process as well as availability of financial aid and scholarships to students and parents.

Prairie View A&M University

Increasing Engineering Students Using Summer Program Approach

Project Leader: Dr. Warsame Ali and Dr. John O. Attia, Department of Electrical and Computer Engineering

Type of Program: Residential, mixed gender program for middle school students

Program Dates: 13-18 June, 2010

Participants: 20 male, 15 female, and 35 African American students

Synopsis:

The objective of the program was to provide an exposure to the middle school students about the exciting world of engineering and to generate an interest in the pursuit of an engineering careers. Using experiments, lectures, and competitive activities, the program was able to develop the skills that will be useful to them in high school and in college.

The program was run by a group of highly qualified faculty and student helpers. Taking this into account no stone was left unturned in ensuring that all students participating in this program received every necessary attention to help them stay interested and excited.

The curriculum and activities, with the aid of technology, helped maintain student interests. Through the Infinity project activities, students learned how engineering plays a role in the subjects they use every day - music, the internet, digital imaging, video, and more. In addition, tools like LEGOS's Mind Storm robots and TI calculators helped students develop a sense of critical thinking, reasoning, and problem solving analysis. Students were involved in building basic Lego race cars and competing in an organized onsite racing event for prizes. Overall, the instructional topics of the camp were Infinity project experiments, basic circuits, basic civil engineering, solar cell vehicle design, engineering applications using the TI calculator, engineering ethics, and strategies for succeeding in college.

The expectation was to instill in middle school kids the self-reliance, skills, and incentive to succeed in the classroom. The students received some elements of the mathematics applications and materials required for success in high school and college. Students also learned life skills by meeting with other students and experiencing how to balance academic and social commitments while living with a roommate, and by being part of a collegiate environment. This environment prepared for the students' transition from middle school to high school and hopefully will also make their college career successful.

Program Content:

- Instruction in math, science and engineering
- Student design team competitions
- Project presentation

St. Mary's University

Pre-Engineering Summer Program in Robotics and Java 3 Programming

Project Leader: Dr. Ozgur Aktunc and Dr. Wenbin Luo, Department of Computer Engineering

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 14 -19 June and 21-26 June, 2010

Participants: 22 male, 6 female, 19 Hispanic, and 1 African American students

Synopsis:

Part 1: The Java programming language was introduced to students using Alice, an interactive 3D-programming environment developed at Carnegie Mellon University. Alice was used to offer the best possible first exposure to programming for students by providing a more intuitive environment for teaching object-oriented programming.

Students learned to design and compile programs, learned the basic constructs of a programming language, and practiced their new knowledge on fun projects. The exercises throughout the week focused on media computation which involved writing programs that modify pictures, movies, and audio.

Part 2: Mindstorm NXT Robot were used and programmed with the ROBOTC Interface. Students worked with the light, sound, touch, and ultrasonic sensors.

Program Content:

- Student team competitions – Students actively participated in team competitions by implementing daily Mindstorm NXT robotics projects. Each team consisted of two students, which allowed them to do hands-on work and communicate to their partner during the project efficiently. The projects were chosen to improve students' knowledge in math, science, and engineering, and critical thinking to solve practical problems.
- Project presentations – After each project, students made project presentations, demonstrating how they approached the problem, developed, and implemented the solution. In Alice programming, the students had individual projects, where they developed a virtual world or an animation, and they presented their projects on the last day of the program to other students and their families.
- Industry Site Visits – An intended field trip to the Southwest Research Institute had to be cancelled because of difficulties receiving authorization to visit the site.
- Panel or luncheon discussions with professional engineers and scientists – The program included alumni speakers from industry and academia. Students learned about the engineering profession, different engineering disciplines, and the under graduate education of engineering, especially that of St. Mary's undergraduate programs.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – St. Mary's staff from the undergraduate admissions office informed the students about the university application process, financial aid, scholarship opportunities, and on-campus housing.
- Other – We had a reception for students and their parents on the last day of the program. The students received certificate-of-completion awards for the summer program following their final project presentation. Parents had the opportunity to speak to the university's faculty members about the engineering summer program and the school's engineering undergraduate programs.

Texas A&M International University

TAMIU Summer Engineering Program

Project Leader: Dr. Rafic A. BAchnak and Dr. Rohitha Goonatilake, Department of Engineering, Mathematics, and Physics

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 19-23 July, 2010

Participants: 11 male, 12 female, and 21 Hispanic students

Synopsis:

The program featured team competitions, project presentations, field trips, industry site visits, panel discussions with professional engineers and scientists, parent/guardian information covering the Texas university application process, financial aid system, and scholarship opportunities.

Throughout the week-long program, the participants prepared for the final project to be presented on the last day. As for the subject matter in the profession, two sessions accomplished a very important portion of the program. One was on "Engineering design projects using AutoCAD," and another was "LEGO robot session," followed by "LEGO robot competition for the participants." Winners of the competitions were recognized with awards. All participants received a certificate of completion.

Program Content:

- Student team competitions – LEGO robots were covered in two sessions. Students were given the opportunity to design and build their own robots and participate in a competition.
- Project presentations – Participants prepared and delivered a final project presentation.
- Industry Site Visits – Participants visited the City of Laredo Utilities Department's water treatment plant.
- Panel or luncheon discussions with professional engineers and scientists: A panel discussion was organized that included a group of six professional engineers and that discussed "What Engineers Do."
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – A session was devoted to cover the Texas university application process, financial aid system, and scholarship opportunities.
- Other – Mathematics and engineering sessions covered the basic foundations for engineering education.

Texas A&M University

Electrical and Computer Engineering (ECE) Unplugged

Project Leader: Dr. Karen Butler-Purry and Ms. Jackie Perez, Department of Electrical and Computer Engineering

Type of Program: Residential, mixed gender program for high school students

Program Dates: 27 June - 2 July, 2010

Participants: 23 male, 7 female, 8 Hispanic, and 5 African American students

Synopsis:

The program was designed to give academically talented high school juniors and seniors interested in electrical and computer engineering an opportunity to explore the fields. Students participated in hands-on projects, laboratory tours, and took an industry field trip. Current faculty and students shared their experiences while leading the projects and tours.

All of the participants were from different schools, developed friendships, and continue to maintain contact with camp counselors and Texas A&M students through internet social networking sites. Library staff is using footage from the week for a video encouraging students to participate in summer programs and encouraging diversity in the field of engineering.

Hands on Projects included the following projects:

- Speaker Project: participants built a woofer and a tweeter speaker that they connected to an audio device;
- Amplifier Project: participants used an amplifier to increase the volume of a sound signal and increased the sound by filtering frequencies between a woofer or a tweeter;
- Pocket Theremin: participants built a pocket Theremin that uses lights to produce different pitches in sound;
- Antenna Project: participants learned how wireless signals operate in a waveguide using a tin can; they calculated antenna placement for the best signal amplification;
- Masking Project: participants saw how microchips are fabricated; they etched the Texas A&M logo and their names onto a wafer; participants had to wear lab coats, glasses, and proper safety attire during this project; and
- Robot Project: participants learned how components can be put together to create a simple robot that can perform a single task and a robot that can follow a maze or compete in a race.

Program Content:

- Student team competitions – Competitions were conducted in the Beambots robot project.
- Project presentations – Participants demonstrated the projects for family and faculty on the final day of the camp. They showed their success and creativity in programming the robots and explained what they learned through the various projects.
- Industry Site Visits – All participants and four staff members traveled to National Instruments, Austin, for a full-day site visit.
- Panel or luncheon discussions with professional engineers and scientists: A luncheon discussion with professional engineers was held at National Instruments. Faculty visited with the participants answering questions and shared their experiences.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Representatives from the Texas A&M office of Admissions, Scholarships, and Financial Aid spoke with the parents and participants on the first day of the program. Brochures on housing were also provided.

Texas A&M University at Galveston

Galveston Ocean (GO) Engineering Week

Project Leader: Dr. Elizabeth Turner and Ms. Daisy Duerson, University Outreach

Type of Program: Residential, mixed gender program for middle and high school students

Program Dates: 2-6 August, 2010

Participants: 20 male, 9 female, 9 Hispanic, and 6 African American students

Synopsis:

The curriculum reflected the Texas A&M University at Galveston's uniquely water-oriented perspective. Students were challenged to capture their experiences with digital cameras and PowerPoint presentations that they presented at the end of the week. Throughout the week students engaged in several team-building activities. They exhibited excellent behavior working together in diverse teams. They learned to be respectful of each other while developing ideas, thoughts, and strategies and all were able to contribute for reaching their goals.

Students received resources, instruction, and support so they could design, engineer, and build a fully functional underwater remotely operated vehicle (ROV) and an autonomous underwater vehicle (AUV). Students were exposed to the different engineering challenges faced in the submarine environment. They were involved in problem solving, critical thinking, teamwork skills, and applying math in the context of science. They were introduced to laboratory safety, electric circuits, construction of PVC structures, and engineering issues related to oil drilling.

Students had the opportunity to interact, interview, and observe engineering professionals and students. This gave them an opportunity to comprehend the global reach of ocean engineering and science, since many faculty and former students work on projects far from the Galveston area.

Program Content:

- Student team competitions – Students competed individually and in teams designing an AUV and underwater ROV.
- Project presentations – Students worked in teams to research an engineering career choice, create a PowerPoint presentation, and present to peers, parents, and engineers at the program's closing ceremony.
- Field Trips – Students visited NASA and the USS Cavalla.
- Industry Site Visits – Students toured the TAMUG training ship, simulator, and engineering laboratories.
- Panel or luncheon discussions with professional engineers and scientists – Students were able to engage in discussion with the chief engineer of the TAMUG training ship, engineers at NASA, and engineering students from Texas A&M University and Texas A&M University at Galveston.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Parents were invited to attend the program's closing ceremony. Detailed informational packets were distributed to parents and students at that time.
- Other – Students were each given the book "Rocket Boys," a math workbook, and a journal. They read the book and worked on the math workbook in the evening.

Texas A&M University–Commerce

Engineering Summer Program 2010

Project Leader: Dr. Brent Donham and Dr. Matthew Elam, Department of Industrial Engineering and Technology

Type of Program: Mixed-gender day program for middle school students

Program Dates: 7-18 June, 2010

Participants: 18 male, 18 female, 9 Hispanic, and 5 African American students

Synopsis:

Using Lego Mindstorms as well as Parallax Boe-Bot robotic kits, students built robots to accomplish defined missions. Students had to employ basic robotic, mathematical, mechanical, electronic, and programming principles. As exercise in structural design, student teams designed freestanding towers constructed with spaghetti, string, and tape for the goal of supporting a single, large marshmallow on top.

The ESP program was held in conjunction with an NSF funded M2T2 project, a two-week mathematics and science program. The ESP added an engineering component to that program. Without the synergistic collaboration, students would not have been exposed to the field of engineering.

Program Content:

- Student team competitions – Teams were judged not only on how the robots performed the required tasks or on performance and innovativeness of their structures, but also on required design documentation in an engineering notebook.
- Project presentations – Industry engineers reviewed the student engineering notebooks and provided feedback to team members. During the LEGO robotic competition, the panelists visited with each team while they were not competing. This allowed teams to discuss their designs, and the challenges they faced and innovative ideas they implemented.
- Industry Field Trips – Students went on a guided tour of the L-3 Communications Integrated Systems plant in Greenville, Texas. Engineers gave presentations about simulation/modeling, unmanned aerial vehicles, sensors, and data compression, all topics of the program's curriculum. The visit included a tour of the air traffic control tower and aircraft hangers where airplanes were retrofitted and rebuild. Students had a look at autonomous unmanned drones.
- Panel or luncheon discussions with engineers and scientists – A lunch panel discussion with engineers from a variety of companies highlighted careers and engineering disciplines associated with aeronautical, electrical, mechanical, manufacturing, and industrial/systems engineering. The panelists participated as judges in the robotics competition.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – As middle school students, participants did not receive a formal session dedicated to financial aid and the application process. Educational opportunities were a focus throughout the week. Texas A&M-Commerce students, including three female industrial engineering students, served as program leaders and mentors.

Texas A&M University–Corpus Christi

Engineering Summer Program 2010

Project Leader: Dr. Petru-Aurelian Simionescu and Ms. Korinne Caruso, Mechanical Engineering and Engineering Technology Division

Type of Program: Mixed-gender day program for high school students

Program Dates: 26-31 July, 2010

Participants: 12 male, 4 female, and 13 Hispanic students

Synopsis:

The program introduced participants to mechanical engineering through the design, construction, testing, and computer simulation of a small-sized counterweight trebuchet. Students simulated the trebuchet using Working Model 2D dynamic simulation software (www.design-simulation.com/WM2D/) and compared the simulation results with experiments.

Students derived and solved analytically the equations of motion of the projectile and compared their calculations with those obtained using Working Model 2D software. Teams competed with their trebuchet prototype for accuracy and range. They gave oral presentations about their design and construction. The best three teams received scholarship prizes in tuition credit for Texas A&M University-Corpus Christi.

Students took field trips to the Corpus Christi Army Depot (CCAD) helicopter repair facility and the City of Corpus Christi Solid Waste Operations' waste recycling facility.

Program Content:

- Student team competitions – Students competed for projectile-launch accuracy and range with small-scale trebuchets that they designed and build.
- Project presentations – Students gave oral presentations about their mechanical designs.
- Industry Field Trips – Students visited the JC Elliott Transfer Station and Citizen Collection Center, Cefe Valenzuela Landfill, which is operated by the City of Corpus Christi, as well as Dolphin Recycling Inc. This gave the participants an opportunity to increase their awareness of environmental issues.
- Industry Site Visits – During their visit to CCAD participants learned about opportunities for engineering co-op students and employment opportunities for professionals.
- Panel or luncheon discussions with engineers and scientists – During the field trips and site visits students interacted formally and informally with engineers. The engineers talked about their career history and life improvement opportunities.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – A seminar about the university application process, financial aid system, and scholarship opportunities was given to the students and to their parents/guardians during the last day of the program.

Texas A&M University–Kingsville

Engineering and Science Frontiers (ESF) Summer Program

Project Leader: Dr. Muhittin Yilmaz and Dr. Jianhong Ren, Department of Environmental Engineering

Type of Program: Mixed-gender day program for high school students

Program Dates: 19-23 July, 2010

Participants: 25 male, 8 female, 22 Hispanic, and 1 African American students

Synopsis:

Eleven engineering and science research projects allowed eleven student teams of three students each to be exposed to advanced research topics with maximum hands-on experience. The projects promoted student enthusiasm for the fields of engineering and science. Professional engineers from industry as well as undergraduate/graduate students addressed the participants. Engineering notebooks and oral presentations reinforced teamwork, communication, and writing skills. A field trip took students to the Port o Corpus Christi facilities. College staff offered detailed information about the university application process.

Program Content:

- *Sustainable Manufacturing and Energy Saving Product Design* – Students evaluated product energy consumption through the whole life cycle by disassembling cell phones and laptops.
- *Citrus Waste Conversion to Biofuels and Chemicals* – Students explored the rudiments of making solid, heterogeneous catalysts by impregnation of various noble metal salt solutions onto various catalyst supports, thus creating a “library” of catalysts.
- *Antenna Design for Wireless Communication Systems* – Students learned principles of the antenna systems and investigated the performance of a wide range of antenna types and systems.
- *Impact of in Vivo Ozone in Human Health* – Students researched molecular mechanisms underlying sciatic nerve inflammatory damage in diabetes effected by air pollution exposure.
- *Programming a Four-wheel Drive Mobile Robot with 4-Degrees of Freedom Robotic Arm* – Students conducted research in robotics and became familiar with associated hardware, software, and programming techniques.
- *Design of a Truss System* – Students designed a balsa wood bridge, assessed a real-world problem, and developed feasible solutions to the problem.
- *Global Warming? Let's Get Some Help from the Satellites* – Participants downloaded satellite data from two different years and monitored changes in coastal glaciology and glacial feature distributions of the Antarctic ice sheet.
- *Air Quality*. Students used air emission control technologies in the laboratory to understand the fundamentals of oxidation, absorption, and bio-filtration control technologies.
- *Enhanced Learning with 3-Dimensional Animation* – Students researched 3-D interactive animation techniques, software tools, and video game design approaches.
- *Desalination of Seawater using Gas Hydrates* – Students worked out a flow diagram for the gas hydrate desalination process and calculated energy required for seawater desalination.
- *Application of Quaternions to Two-Player Two-Strategy Games* – Students explored various examples of two-player, two-strategy games theory. They studied the characteristics of the associated Nash equilibria, covered the special number system, called as Quaternions, during the implementation of usual operations and conducted research on enlarging the strategic sets of the players.

Texas A&M University–Texarkana

Introductory Robotics Program for Middle and High School Underrepresented Students with Emphasis in Role Models

Project Leader: Dr. Victor Govindaswamy, Dr. Arthur Linkins, and Dr. Igor Aizenberger,
Department of Electrical Engineering and Computer Science

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 2-6 August, 2010

Participants: 12 male, 12 female, 1 Hispanic, and 11 African American students

Synopsis:

The program featured an introduction to robotics engineering for middle and high school students. To attract the best students into engineering only twenty-four applicants, those with the highest GPA for math and science, were accepted and receive a stipend of \$100 after successful completion of the program. The program provided breakfast and lunch for the students, the cost for which was sponsored.

The week-long program consisted of several sessions in which the participants learned to assemble, program, and debug the LEGO NTX robot kits. They gained the necessary mathematical skills to understand the basic concepts behind the robots' design. The long term objective was to improve their confidence and interest in engineering.

Throughout the week students were grouped into pairs. Since each pair had its own kit, both members had to collaborate in order to reach the set goals. Each day began with a short lecture by the main program counselor, who covered topics relevant for the day. Throughout the program the participants were advised and supervised in technical matters by the main counselor and the program counselors. Therefore each counselor was in charge of supervising not more than three pairs of students. This allowed very close and personal attention to each of the participants. There were also team robotic competitions for which trophies were handed out to the winners.

Most program sessions concluded with a discussion with successful role models in a given engineering field or mathematics. By providing the participants the opportunity to speak with professionals who were highly successful in engineering or mathematics the program hoped to make opportunities in engineering more tangible to the students.

During breakfast and lunch each day program counselors shared their experiences of studying engineering with participants. The Office of Recruitment at Texas A&M-Texarkana provided information to students, parents, or guardians about the university's application process, financial aid system, and scholarship opportunities during the closing ceremony on Friday.

Many of the participants had not had any previous experience with engineering. The program created an immediate interest and showed that engineering can be fun and, at the same time, requires focus and hard work.

Texas State University–San Marcos

Bridge Design and Prototyping Research Program

Project Leader: Dr. Bahram Asiabanpour, Department of Manufacturing Engineering, and Ms. Nicole DesChamps-Benke. Department of Arts and Design

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 19-26 July, 2010

Participants: 10 male, 10 female, and 5 Hispanic students

Synopsis:

The program implemented a novel outreach to middle and high school students to familiarize them with engineering functions and methods. The project was a design research project for a bridge across the San Marcos river. Students participated in a seven days long research program, during which they learned many engineering skills and tools, such as CAD solid modeling, design considerations, finite element analysis, artistic elements, rapid prototyping, mechanical tests, team work, and communication skills. The end-of-program survey showed a good understanding about the engineering skills and functions and a high degree of satisfaction among participants.

Program Content:

- Student team competitions – Four teams of students competed against each other. The criteria were robustness of the design based on finite element analysis, artistic form and texture, bridge prototype and landscaping, poster design and presentation.
- Project presentations – Students presented their work by means of a poster presentation, a bridge demonstration, and PowerPoint presentations.
- Field Trips – Students went on a field trip to the San Marcos river during which they measured the specifications necessary for their design, such as the depth, width, and flow of the river water.
- Site Visits – Several laboratory and workshop visits and hands-on experiments were provided in the School of Engineering, Department of Engineering Technology, and School of Art and Design.
- Panel or luncheon discussions with engineers and scientists – A guest speaker, who was an inventor and patent holder, gave a presentation about creativity and innovation. Experts discussed the students' work with them during the final presentation of the last day of the program.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Parents were invited for the final presentation on the last day and Texas State University staff provided information about the institution's engineering programs and opportunities in the engineering job market.

Texas Tech University

Real World Engineering: Robotics

Project Leader: Dr. Bobby Green, Department of Construction Engineering and Engineering Technology and Dr. Richard Gale, Department of Electrical Engineering

Type of Program: Girls-only day program for high school students

Program Dates: 7-11 June, 2010

Participants: 28 female, 11 Hispanic, and 6 African American students

Synopsis:

The program was a all-female program for students who would be first-generation college students. The participants performed basic experiments in mechanics, statics, and electronics. They used hand tools to perform several tasks. The students had presentations in engineering ethics, project management, economics, math, physics, electromechanical robotics, solid state electronic circuit fabrication, and manufacturing practices.

Students engaged in hands-on building of electronic circuits to perform a variety of functions by modifying the same basic circuitry. Examples were blinking Light Emitting Diodes of different colors or creating sounds of different types. Students learned some of the basic physics behind controlling the timing function of electronic circuits by charging and discharging capacitors at different rates.

Learning objectives:

- Safety equipment used with hand and machine tools.
- Safety with hand tools and simple machine tools: drill press, band saw, etc.
- Practice project scheduling to schedule time and effort from starting a project to reach completion in six to eight weeks.
- Mechanical design: brain storming, design activities, material selection, etc.
- Electronic controller programming for combined remote control and autonomous robot.
- Flow chart development for programming, mechanical design, and project scheduling.
- Leadership building, team building, developing redundant skill sets in a team.
- Game strategy: trade off analysis. Determine the worth of each task and then determine a path to maximize the return (in these cases points per task) on the robot investment and based on the team's particular robot design capabilities.
- Every student had to keep a detailed laboratory notebook of the team's project.

Program Content:

- Student team competitions – Students were grouped to form one or more two-person teams.
- Project presentations – The teams presented short oral progress reports at the end of each project.
- Panel or luncheon discussions with professional engineers and scientists – Short presentations and discussion from area engineers during classroom time.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – TTU Enrollment Management personnel and the Whitacre College of Engineering gave presentation to parents and guardians about ApplyTexas, the Texas common admissions and scholarship application.

The University of Texas at Arlington

Entry to Engineering and Computer Science Summer Program

Project Leader: Dr. Carter Tiernan, College of Engineering

Type of Program: Mixed-gender day program for middle school students

Program Dates: 5-9 July, 2010

Participants: 39 male, 11 female, 4 Hispanic, and 5 African American students

Synopsis:

This one-week program was designed to provide students with a broad exposure to a variety of engineering disciplines – aerospace, biomedical, civil & environmental, computer science, electrical, materials science and mechanical – plus related topics in chemistry or physics. Field trips to area businesses, hands-on take-home individual projects, and engineering team activities supplement the classroom events. The Entry program was a 9 a.m. to 5 p.m. day program limited to 50 students, with a Monday morning family orientation session and a Friday evening awards session.

The learning objectives were that a student who attended the program was able to describe at least four areas of engineering based on the faculty talks and field trips, built a working engineering team project, created a PowerPoint presentation describing their project with their team, presented their project to the other participants in a formal setting, and developed an even more positive attitude about an engineering career than when they started the program.

Program Content:

- Student team competitions – Students chose one of seven engineering projects and formed teams of two to four students. The teams that worked on the same kind of project competed with one another on the final day.
- Project presentations – The project teams were required to produce a PowerPoint presentation about their project and to give that presentation to their peers on the final day. Every team member was required to take part in the oral presentation with the PowerPoint presentation.
- Industry site visits – Students took two site visit trips. They visited the Fort Worth Star-Telegram and the US Bureau of Engraving and Printing facilities. On each trip students toured the facility, learned about how engineering is used in that industry, and asked questions of the staff at the facility.
- Panel or luncheon discussions with professional engineers and scientists – Professional engineers came to the program and worked as project mentors, interacting with the students as they create their engineering team projects. The students were able to talk one-on-one with these visiting mentors and to ask questions about their careers.
- Other – Talks and hands-on activities presented by UT Arlington faculty members gave participants a taste of the many different types of engineering they could pursue. During the course of the program, students experienced college life by visited classrooms, labs, and dining facilities on UT Arlington's campus.

The University of Texas at Austin

Consider Every Option (CEO)

Project Leader: Ms. Tricia Berry, MBA, Women in Engineering Program, and Ms. Andrea Ogilvie, P.E., Equal Opportunity in Engineering Program, Cockrell School of Engineering

Type of Program: Girls-only day program for high school students

Program Dates: 7-11 June, 2010

Participants: 30 female, 4 Hispanic, and 3 African American students

Synopsis:

The program was open to students with a strong interest in engineering, science, and math. Outstanding African American, Hispanic and Native American students, female students, and those who have overcome any social or economic hardship were strongly encouraged to apply. It provided 30 high school students with the opportunity to explore engineering through hands-on technology and engineering-based team projects. Participants attended interactive workshops that introduced various engineering disciplines and the college admissions process. Participants were exposed to engineering role models and established an ongoing support network and a connection to university resources.

Each day, participants:

- discovered a variety of engineering areas and exciting career options;
- explored their interests through sessions (tours, presentations, and activities) led by industry professionals, engineering faculty, and graduate students; and
- experienced the creativity of engineering design through hands-on engineering projects.

Program Content:

- Student team competitions – Students worked in groups each day to complete a design challenge centered around the engineering theme for the day.
- Project presentations – Students shared their design challenge solutions in front of all participants at the end of each day.
- Field trips: On campus visits to labs such as the visualization lab and the aerospace engineering wind tunnel were included throughout the program.
- Panel or luncheon discussions with professional engineers and scientists – Engineering faculty and engineering industry professionals presented workshops, hands-on activities and panels each day of the camp. They also participated in the “Lunch with an Engineer” each day of the program.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Two parent/guardian sessions were hosted during the week to cover the application process, financial aid, housing, scholarships, transitioning into college, and other important issues. Parents/guardians had the option to either attend the session on Monday or the session on Friday, whichever was most convenient.
- Other – Current engineering students served as tour guides, activity facilitators, mentors and student panel panelists throughout the program. Various ice breakers and “get-to-know you” activities were hosted throughout the program to build community and connect the students to UT and each other.

The University of Texas at Brownsville and Texas Southmost College

E.T. at UTB/TSC "Engineering Teens" Summer Program 2010

Dr. Peter B. Gawenda, College of Applied Technology and General Studies, and Mr. Jose G. Amieva, Department of Industrial Technology

Type of Program: Girls-only day program for high school students
Program Dates: 14-18 June, 2010
Participants: 20 female and 20 Hispanic students

Synopsis:

The participants came from different schools in Brownsville. These students were exposed to many activities that involved science, technology, engineering, and math. The students started by learning how to fly a kite and ended up assembling and running an educational robot made by VEX. The program included physics education, e.g. they learned the three Newtonian laws and how to use liquid nitrogen in the laboratory. Professional engineers from industry interacted with students in question and answer sessions.

Students made their final presentations with enthusiasm in front of their parents.

Curriculum:

- Math lectures: a math review with applications and simulations.
- Physics lectures: an introduction to physics with application of Newton's law.
- Engineering lectures: an introduction to engineering with a survey of all the different careers that are in engineering.
- Computer applications lectures: introduction to LabView for engineering.
- Team project presentation: every student team presented research about such topics as renewable energy or robotics.
- Student presentation: the student presented work using PowerPoint and/or poster boards.

Program Content:

- Student team competitions – The students took part in four competitions including a robot competition. They had to assemble the robot and prepare it for a robot sumo wrestling competition.
- Project presentations – The program required the students to give presentations for four program and one final projects.
- Field Trips – Participants visited The University of Texas at Brownsville and learned about financial aid and programs of study the institution has to offer.
- Industry site visits – Participants visited AMFELS, a manufacturer of offshore oil rigs and they visited the water desalination plant of the Public Utility Board.

The University of Texas at El Paso

Innovation Challenge to Recruit Students into Engineering Education at UTEP

Project Leader: Mr. Gabriel Gándara, Department of Undergraduate Studies and Engineering Education Research

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 28 June – 2 July, 2010

Participants: 13 male, 8 female, and 20 Hispanic students

Synopsis:

The program utilized a variety of activities to engage students in exploration, awareness, and preparation to what is required for success in an undergraduate degree program at The University of Texas at El Paso.

Activity modules were:

- Be a robot module
- CYBERSHARE computer science laboratory demo module
- Cardboard canoe design, construction, and races module
- Build a PC module
- Egg drop competition module
- College prep module
- Lego assembly competition module
- Straw bridge module
- Visualization module
- Alarm clock module

Collaboration with school districts and the Upper Rio Grande Workforce Solutions set a precedent and indicates that the program could grow and target more students. The program at UTEP was a great success and should renew the focus on students entering the STEM fields. At the same time, new partnerships with research laboratories fueled the program's content and curriculum and made program activities more real for the participants.

Program Content:

- Student team competitions: Students competed in smaller competitions during the modules work throughout the week. The core competition revolved around the design and building of the cardboard canoe races.
- Project presentations: Students presented their projects.
- Field trips: Students visited the The University of Texas at El Paso's Center for Space Exploration Technology Research.
- Panel or luncheon discussions with professional engineers and scientists: Participants had lunch with undergraduate engineering students throughout the week and also took part in a cookout with engineering faculty and staff.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities: Students attended a college preparatory activity on the second day of the program. Parents were invited and introduced to these processes during the welcome and introductory portion of the week.

The University of Texas at Tyler

RISE/DIVE 2010 Summer Engineering Program

Project Leader: Dr. James K. Nelson Jr., and Ms. Jennifer H. Scott, College of Engineering and Computer Science

Type of Program: Mixed-gender residential program for high school students

Program Dates: 11-16 July, 2010

Participants: 26 male, 3 female, 8 Hispanic, and 3 African American students

Synopsis:

Students participated in one of three main design and construction activities for the week: for activity RISE they worked on a high altitude experimental capsule, for activity DIVE they worked on a submersible robot, and for activity THRIVE they worked on an “indestructible” display robot. Smaller activities focused on the fields of electrical engineering, computer engineering, computer science, civil engineering, and mechanical engineering:

- o Fiber optics and polarized light
- o Electromagnetic waves
- o Programming of Field Programmable Gate Arrays
- o Anechoic chamber
- o Circuits
- o Assembly of a desktop computer
- o Computer aided K'nex bridge design considering weight to load ratio
- o Model airplane design construction based on lift, weight, and drag
- o Marketing of a model airplane based on engineering specs

The program's learning objectives were that students should:

- o gain a better understanding of engineering as a profession;
- o how to prepare for engineering education;
- o understand the engineering design process; and
- o develop skills for working on teams.

Generally, the high school students were prepared both academically and socially to tackle the activities. The program's student mentors assisted the participants with their projects.

Program Content:

- Student team competitions – Students worked in competitive teams for the smaller activities, such as the bridge design according to specified constraints. Students also worked on teams for the week-long emphasis areas RISE, DIVE, and THRIVE.
- Project presentations – Every student was assigned to one design team for the week and each team prepared poster presentations for the Friday afternoon parent reception.
- Field Trips – Students visited “mission control” of the NASA Columbia Scientific Balloon facility and saw a film about the activities, research, and payloads for balloon launches around the world. They visited with engineers and scientists at the facility.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Students did a computer research activity on how to locate admissions and scholarship information for different colleges, and also how to research engineering fields through websites of professional societies or college board career and majors information.
- Other – Students had opportunities to meet recreationally other students that were exploring college and career opportunities.

The University of Texas of the Permian Basin

UTPB Academy Engineering Summer Program 2010

Project Leader: Dr. Raj Desai and Mr. Reynaldo Lascano, Department of Continuing Education

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 7-11 June, 2010

Participants: 12 male, 9 female, and 12 Hispanic students

Synopsis:

The students were able to learn the value of team work through competitions and presentations. They also obtained an insight into college life by being on campus and using the university's resources such as computers and the library. The activities allowed the students to find new and creative ways of making something work, just like an engineer would do in real life. Engineering professionals gave informative talks about available engineering careers.

Projects included:

- o basic electric circuits and their components, input/output devices, LED's, solar cells, generators for wind energy;
- o energy experiments with solar powered water well winch and conveyor, discussion of energy and pollution and the conservation of energy;
- o hovercraft building project; and
- o catapult building project.

Hands-on activities taught students how to measure wind speed, calculate RPM, and determine optimum pitch angles. Along the way they learned how to test, evaluate, and solder. Better time management were also stressed through adherence to schedules given for the projects.

The program gave an introduction to engineering, including: philosophy of engineering, history of engineering, engineering principles, engineering ethics, engineering professionalism, the engineer as a communicator, and the engineering workplace.

Program Content:

- Student team competitions – Student team competitions allowed the students to test the durability of their finished product and the innovative aspects of designs by other students.
- Project presentations – Presentations were a part of everyday activities so that the students were able to share their findings and present their results to other teams.
- Field trips: – Students visited and toured the Science Spectrum Museum in Lubbock, TX. They had the opportunity to watch the IMAX movie "Storm Chasers" at the museum.
- Panel or luncheon discussions with professional engineers and scientists – Professional engineers and scientists discussed possibilities given through engineering. A professor of the Nuclear Physics Engineering department discussed and demonstrated the basics of science and engineering. The project coordinator for the High-Temperature Teaching and Test Reactor (HT3R) spoke about nuclear energy and engineering education at The University of Texas of the Permian Basin.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities – Staff from the Financial Aid office and the director of the Admissions office discussed the different types of financial aid available to students and the admissions requirements and process.

The University of Texas-Pan American

PREP Plus+ Engineering Summer Program 2010

Project Leader: Dr. Stephen W. Crown and Dr. Javier Kypuros, Department of Mechanical Engineering

Type of Program: Mixed-gender residential program for high school students

Program Dates: 11-16 July, 2010

Participants: 21 male, 19 female, and 40 Hispanic students

Synopsis:

PREP Plus+ provided 2nd year Texas pre-freshman Engineering Program (TexPREP) students with a one-week on-campus residential experience during which their regular TexPREP curriculum was enhanced with an Introduction to Vehicle Dynamics course. Students built working, battery-operated, scaled cars instrumented with sensors and microcontrollers that measured vehicle acceleration. In the evenings students also built 10 Lego Mindstorms NTX humanoid robots for a dance competition on the final day of the program for school administrators and parents. While on the UTPA campus, students participated in campus life activities.

The Introduction to Vehicle Dynamics course introduced students to engineering principles associated with analyzing, designing, modeling, and measuring vehicle dynamic responses, while using basic algebra, geometry, and physics. Students built working, battery-operated, scaled cars instrumented with sensors and microcontrollers that measured vehicle acceleration. Materials used included a kit car with DC electric motor and instrumentation to measure and plot vehicle velocity and acceleration.

The ERP-ESP program impacted the entire TexPREP program as enrollment increased from 175 to 347 students in the two years since our first ESP program. Students are drawn to and retained in these symbiotic programs because of the "college experience" that was afforded to students through the ESP program: ESP allowed students to live on campus and participate in an accelerated engineering short course with a university professor.

Program Content:

- Student team competitions: Students worked in groups of two to three to design, build, and test an instrumented dune buggy model vehicle. A performance competition was carried out during the final day of the camp.
- Project presentations: Students presented their designs and tested run data in a short report and made a brief presentation to the class.
- Field trips: Students were taken on a tour of the engineering lab facilities for the mechanical, electrical, and manufacturing engineering programs at The University of Texas-Pan American.
- Panel or luncheon discussions with professional engineers and scientists: Several presentations by local scientists and engineers were held for the TexPREP program including one on the final day of the camp.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities: Students heard a presentation by staff from Enrollment and Student Services and had access to browse the online services.

University of North Texas

Game Programming for Xbox 360 Summer Program

Project Leader: Dr. Robert Akl and Mr. David Keathly, Department of Computer Science and Engineering

Type of Program: Mixed-gender day program for middle and high school students

Program Dates: 28 June – 2 July, 2010

Participants: 28 male, 3 female, 3 Hispanic, and 3 African American students

Synopsis:

The program was a game design and programming program and was organized around team- and project-oriented activities that utilized laptops, XNA Framework (which is provided by Microsoft), and Xbox 360 gaming consoles. By using gaming as the backdrop, students learned coding and programming principles and developed an understanding of the role of physics and mathematics in game design. Topics were car-racing games and side-scrolling platform games. Students justified and presented their designs to parents and friends on the last day of the one-week program.

The curriculum consisted of open-ended projects that produced observable behaviors and allowed students to explore beyond the limits of the defined exercises. Even though the students were provided with templates that they modified, they were able to change many aspects of the games, including graphics, sound, physics, scoring, and objectives. Being able to “play” the games provided tangible means to see the results of their programming. Students presented and were asked to justify their design decisions. Teams also competed against each other; not only in trying to see which team had the better game but also in playing the games that they developed.

Program Content:

- Introduction to Microsoft’s XNA Game Studio
- Programming in X# with XNA framework
- Creating a new project
- Loading, editing and saving projects
- Platform game customization
- Modifying levels, tiles, and backgrounds
- Adding and changing sound
- Player animation
- Role-playing game customization
- Modifying objectives and scoring
- Modifying characters
- Working with combat and AI
- Game graphics, items, and quests
- Racing game customization
- Modifying textures and tracks
- Level design
- Car physics
- Presentation and demos to parents and friends

West Texas A&M University

Engineering Summer Program 2010

Project Leader: Dr. Freddie Davis and Ms. Rhonda B. Dittfurth, Department of Engineering and Computer Science

Type of Program: Mixed-gender residential program for middle and high school students

Program Dates: 13-18 June, 2010

Participants: 67 male, 25 female, 26 Hispanic, and 7 African American students

Synopsis:

Program participants were given an overview of several different types of engineering. The main focus of the camp was on renewable energy with special attention given to wind and solar energy. Participants also had two sessions introducing them to computer science with software engineering.

Curriculum topics were:

- Combustion: understanding combustion and how it is used in rocket engines;
- Greenfoot: basic programming skills;
- Algorithms: basic use and understanding of software algorithms;
- Library: basic instruction on how to conduct research;
- College Prep: instruction on how to be prepared for college and also how to enroll in college;
- Geocaching: foundations of GPS and how it pertains to engineering and how to use a GPS device;
- L.E.A.N.: foundations and principles behind effective manufacturing and distribution;
- Wind: construction of a wind turbine and the use of the generated power;
- CAD: basic and advanced instruction in Computer Aided Design and design creation with the department's 3-D printer; and
- Concrete: basic formulation and understanding of the different types of concrete.

Program Content:

- Student team competitions: Several competitions were held including effectiveness of energy output from a constructed wind turbine, geocaching treasure hunting game, and LEAN manufacturing.
- Project presentations: Student teams presented their final projects for the wind turbine, combustion, CAD, Greenfoot, and concrete activities.
- Field trips:
- Industry site visits: Students visited the Alternative Energy Institute (AEI) Regional Wind Test Center and toured the AEI test building, viewed several different types of wind turbines, and helped with the installation of a small turbine.
- Panel or luncheon discussions with professional engineers and scientists: Each morning the program featured a professional engineer who talked to the students about their daily duties and answered questions. Engineering fields covered were civil, mechanical, electrical engineering, and engineering technology.
- Parent/guardian information that covers the Texas university application process, financial aid system, and scholarship opportunities: Students attended a session on college preparedness, which included a discussion of high school class choices that would prepare them for college admission. The session included information and information packets on applying for college.