SJSU SAN JOSÉ STATE UNIVERSITY

MTI MINETA TRANSPORTATION INSTITUTE

Infrastructure Academy Transportation Program

Hassan Hashemian, PhD

CSUTC California State University Transportation Consortium

CAL STATE LA CALIFORNIA STATE UNIVERSITY, LOS ANGELES

CSU TRANSPORTATION CONSORTIUM

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Mineta Transportation Institute

Founded in 1991, the Mineta Transportation Institute (MTI), an organized research and training unit in partnership with the Lucas College and Graduate School of Business at San José State University (SJSU), increases mobility for all by improving the safety, efficiency, accessibility, and convenience of our nation's transportation system. Through research, education, workforce development, and technology transfer, we help create a connected world. MTI leads the Mineta Consortium for Transportation Mobility (MCTM) funded by the U.S. Department of Transportation and the California State University Transportation Consortium (CSUTC) funded by the State of California through Senate Bill 1. MTI focuses on three primary responsibilities:

Research

MTI conducts multi-disciplinary research focused on surface transportation that contributes to effective decision making. Research areas include: active transportation; planning and policy; security and counterterrorism; sustainable transportation and land use; transit and passenger rail; transportation engineering; transportation finance; transportation technology; and workforce and labor. MTI research publications undergo expert peer review to ensure the quality of the research.

Education and Workforce

To ensure the efficient movement of people and products, we must prepare a new cohort of transportation professionals who are ready to lead a more diverse, inclusive, and equitable transportation industry. To help achieve this, MTI sponsors a suite of workforce development and education opportunities. The Institute supports educational programs offered by the Lucas Graduate School of Business: a Master of Science in Transportation Management, plus graduate certificates that include High-Speed and Intercity Rail Management and Transportation Security Management. These flexible programs offer live online classes so that working transportation professionals can pursue an advanced degree regardless of their location.

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MTI utilizes a diverse array of dissemination methods and media to ensure research results reach those responsible for managing change. These methods include publication, seminars, workshops, websites, social media, webinars, and other technology transfer mechanisms. Additionally, MTI promotes the availability of completed research to professional organizations and works to integrate the research findings into the graduate education program. MTI's extensive collection of transportation-related publications is integrated into San José State University's world-class Martin Luther King, Jr. Library.

Report 20-51

Infrastructure Academy Transportation Program

Hassan Hashemian, PhD

January 2021

A publication of the
Mineta Transportation Institute
Created by Congress in 1991

College of Business
San José State University
San José, CA 95192-02

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
20-51			
4. Title and Subtitle Infrastructure Academy Transportation Program		**5. Report Date** January 2021 **6. Performing Organization Code**	
7. Authors Hassan Hashemian, PhD		**8. Performing Organization Report** CA-MTI-1919	
9. Performing Organization Name and Address Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219		**10. Work Unit No.** **11. Contract or Grant No.** 6 ZSB12017-SJAUX	
12. Sponsoring Agency Name and Address State of California SB1 2017/2018 Trustees of the California State University Sponsored Programs Administration 401 Golden Shore, 5th Floor Long Beach, CA 90802		**13. Type of Report and Period Covered** Final Report **14. Sponsoring Agency Code**	
15. Supplemental Notes DOI: 10.31979/mti.2021.1919			
16. Abstract The College of Engineering, Computer Science, and Technology at the California State University, Los Angeles has expanded its National Summer Transportation Institute into a year-long program by creating the Infrastructure Academy Transportation Program (IATP). The goal of this program is to build a pipeline of diverse, well qualified young people for the transportation industry. The program works with high school students and teachers to offer academic courses, basic skills, workforce readiness training, internships, extracurricular activities, and career placements to prepare students and place them into the Science, Technology, Engineering, and Math (STEM) College track. The academy emphasizes on transportation as an industry sector and aims to increase the number of underrepresented minorities and women who directly enter the transportation workforce. It also aims at increasing the number of young people who enter college to study engineering or technology and subsequently pursue careers in transportation- and infrastructure-related careers. The IATP was conducted as a full-year program with 30 student participants from high schools.			
17. Key Words Workforce Development, STEM, Transportation Career, Transportation Outreach, Transportation Education	**18. Distribution Statement** No restrictions. This document is available to the public through The National Technical Information Service, Springfield, VA 22161		
19. Security Classif. (of this report) Unclassified	**20. Security Classif. (of this page)** Unclassified	**21. No. of Pages** 41	**22. Price**

FORM DOT F 1700.7 (8-72)

DOI: 10.31979/mti.2021.1919

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ACKNOWLEDGMENTS

The author thanks MTI staff, especially Deputy Executive Director Hilary Nixon, PhD. Without her assistance and dedication, this work would not be possible.

The author is indebted to representatives of many agencies who contributed their ideas and valuable time to this project, including: Will McClure, Equal Opportunity Specialist, FHWA; Brian Gallegar, Principal Transportation Engineering, LADOT; Abdollah Ansari, Senior Executive, LAMTA; Anthony Ng, P.E., Chief, Office of Engineering Services, Caltrans District 7; and Mallory Fites, Director at California Transportation Foundation (CTF).

The author also wishes to thank the following individuals for their valuable contributions to this project:

Dr. Mark Tufenkjian, Chair, Civil Engineering, CSULA

Dr. Mehran Mazari, Assistant Professor of Civil Engineering

Donna Melendez, Program Coordinator, Civil Engineering

Peter Gatsby, Program Coordinator Assistant, Civil Engineering

Simon Hasmik, Marketing Specialist, ECST-CSULA Thelma

Federico, Director of Outreach ECST-CSULA Maria Acosta,

Academic Aide, ECST-CSULA

Daniel Davalos, Academic Aide, ECST-CSULA

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Executive Summary

The U.S. federal workforce is rapidly aging and moving toward retirement. At the same time, women and minorities are underrepresented in the transportation field. In response to this predicament, the CSUTC has led an effort to develop a "workforce framework" to be used to educate the transportation workforce of the future. One important focus area is recruitment: outreach to K–12 and college-level women and minority students is considered vital to attracting the talent needed for the future of the transportation community. Targeting the youth of today provides an excellent opportunity to train the next generation of transportation employees.

With the aim being to attract students to the industry, many conversations with local employers, guidance counselors, and students themselves have revealed the following barriers:

- Lack of intrinsic motivation, communication skills, and leadership skills;
- Lack of core math and science skills to pursue a career in a technical area like transportation;
- Lack of student, teacher, counselor, and parent knowledge and resources about career opportunities in transportation and infrastructure;
- Lack of specific job skills needed by the transportation industry;
- Lack of coaching and guidance to pursue specialized careers in transportation and infrastructure;
- Lack of providing access to role models, mentors, sponsorship, and involvement in professional organizations to foster networking; and
- Lack of emphasis on communal goals in transportation networking.

To meet the changing needs of the transportation industry workforce, this project develops and implements programs that would utilize the educational skills of California State University, Los Angeles (Cal State LA) in developing transportation-related skills for high school students, specifically minorities, women, and disadvantaged individuals. The program recruited 30 high school students from 18 schools to be trained in STEM- and transportation-related fields. The program includes but is not limited to developing students' communication skills, leadership, team building and intrinsic motivation, workshops/lecture series in transportation and infrastructure fields, internships, field trips to transportation agencies and presentations by transportation professionals, training in job-relevant skills including workforce readiness, AutoCAD/SolidWorks

software, robotics, and transportation careers guidance counseling for each participant. The program was a full-year program conducted at CSULA.

The IATP workshops and internships sparked our students' creativity and inspired them to view the transportation industry in a new light. The students were well served by the partnership with several transportation agencies and they will undoubtedly continue to benefit from the skills they have acquired through the program as they pursue their educational and career goals.

The internship component of the program was equally valuable, because it gave the students the opportunity to engage in real-world experience that prepared them for entry into the workforce. In addition, the students who completed their internships at CSU LA learned how to use their ingenuity and creativity to solve engineering problems.

Most of our students are first-generation college students from underrepresented communities who might have never considered higher education as an option. The Infrastructure Academy Transportation Program taught our students to collaborate as professional team members and made them feel capable of working in the transportation industry. The program at CSU LA was highly successful and the students who participated have reaped tremendous benefits from the workshops and internship opportunities that were made available to them.

I. Introduction

1.1 Background

In an effort to address the need for a diverse workforce in the twenty-first century and to create an awareness of the career choices and opportunities that exist in the transportation industry, the California State University Transportation Consortium (CSUTC) established educational initiatives to address a crucial workforce need for the transportation industry. With an unprecedented number of transportation employees who are eligible to retire, this is a great opportunity to prepare youth for future engineering- and transportation-related careers.

In 2019, California State University, Los Angeles (CSU LA) was selected to conduct the Infrastructure Academy Transportation Program (IATP) on campus. This program responds to the national need to recruit secondary school students into transportation fields. Tailored to the specific needs and capabilities of the campus, the program enables CSU LA to provide an orientation to engineering and technology programs. The program at CSU LA created an awareness of the attractive career choices and opportunities that exist in the transportation industry. The academy provided students with a greater awareness of how transportation services are planned, organized, and designed, as well as the many functions, relationships, and resources that are needed to coordinate and deliver transportation services in a large metropolitan area.

The IATP was championed through public and private partnerships that included CSUTC, Los Angeles Department of Transportation (LADOT), Metropolitan Transportation Authority (MTA), Federal Highway Administration (FHWA) Division offices, California Department of Transportation (Caltrans), California Transportation Foundation (CTF), private corporations, and neighboring Los Angeles high schools.

1.2 Purpose

The purpose of the CSU LA Infrastructure Academy Transportation Program is to build a pipeline of diverse, well qualified young people for the career opportunities in STEM and the transportation industry. The program increases the number of underrepresented minorities and women who directly enter the transportation workforce as well as the number of young people who enter college to study STEM and subsequently pursue careers in transportation- and engineering-related fields.

1.3 Program Goals

Based on the needs assessment and purpose of the program, CSU LA identified the following six goals to increase the number of young people, ages 15–18, who enter college to study STEM and pursue careers in STEM and transportation- and engineering-related fields.

(1) Recruiting students in neighboring high schools to attract potential candidates to the field;

(2) Developing students' communication skills, leadership, and intrinsic motivation;

(3) Providing instruction on transportation, engineering, and infrastructure;

(4) Providing internships and career placement with transportation agencies;

(5) Offering training in job-relevant skills including workforce readiness, AutoCAD/SolidWorks software packages, Microsoft Office tools, robotics, programming software packages, and construction materials and grading; and

(6) Providing counseling and placement support to college, or immediate career entry upon high school graduation.

II. Student Recruiting

2.1 Goal

The goal was recruiting in neighboring high schools to attract potential candidates to the transportation field.

The IATP staff and undergraduate student assistants met several times to develop the recruitment plan. The plan included identifying neighboring high schools; scheduling visitations and presentations to schools, conferences, and several community groups; preparing applications, required forms, and brochures; and planning the schedule for students' interviews, selection, and notification.

Building on existing relationships between CSU LA University Auxiliary Services (UAS), Mathematics, Engineering, and Science Achievement (MESA), and Minority Engineering Program (MEP), as well as neighboring high schools, we identified 20 potential high schools to be visited or contacted for student recruitment for entry to the program. We visited several of the identified schools and gave presentations in their classes. We also informed the teachers and counselors through mass mailing of brochures and applications. We received 55 applications from students at 18 high schools. We selected 30 students with a waiting list of 25 candidates. We chose at least one student from each high school who met the criteria listed below. The IATP project personnel interviewed potentially qualified students and selected the applicants for admission. Offers of admission to the program were made to students according to the ranking presented in Table 1.

Table 1. Criteria for Student Admissions

GPA	Students must have a minimum 2.0 GPA.
School Status	Students must be concurrently enrolled in a high school and must be on schedule to graduate in June 2020, 2021, 2022, or 2023.
Transportation	Students must be able to attend classes at CSU LA using either public or personal transportation.
Commitment	Students must make a commitment to attend scheduled Saturday sessions during the school year.

Upon completion of the selection process, IATP staff notified the successful applicants and provided them with detailed information about the program. Information provided in the notification/acceptance package included (1) notification award, (2) letter of confirmation, (3) IATP regulations, (4) certificate of health, (5) personal items and dress codes, (6) consent form

soliciting permission to videotape or photograph. The staff also notified applicants who were not selected to participate in the program.

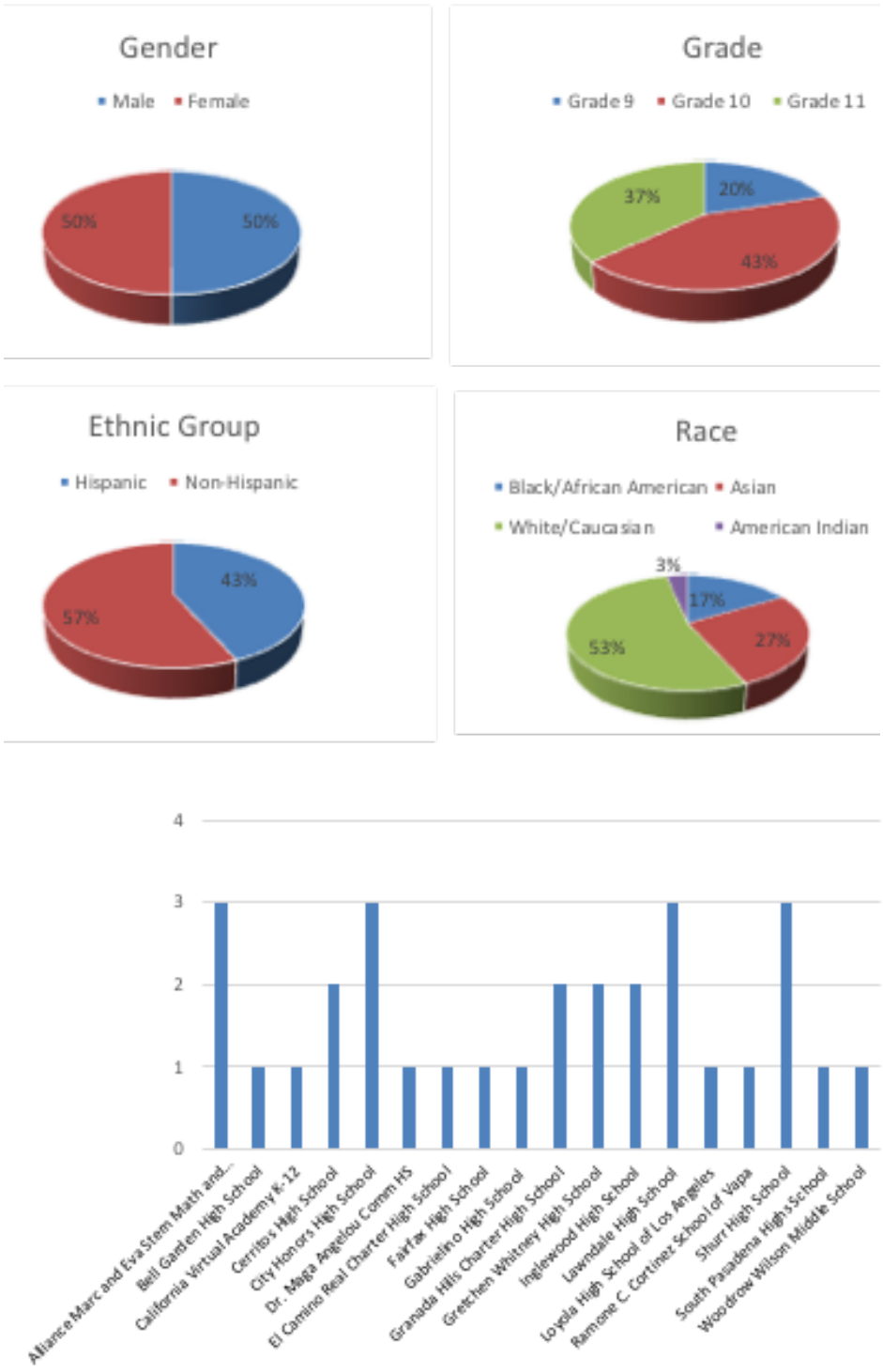
2.2 Measurable Achievement

Fifty-five applications from 18 high schools were received and 30 students selected.

Table 2. ITAP Demographic Summary

Name of Host Site		California State University, Los Angeles					Year Reporting		2019
Dates of Institute		5/01/19	4/30/20						
Program Classification:		X	High School						
Number of Applications			55						
Number of Participants			30						
Number Completing Program			30						
Ethnic Group					Race				
	13	Hispanic			16	Caucasian		8	Asian
	17	Non-Hispanic			5	Black		1	Other
Gender									
	15	Male			15	Female			
Geographic Representation									
Number of Cities		10							
Number of Counties		2							

Figure 1. IATP High School Student Demographic Data



III. Leadership Development Program (LDP)

3.1 Goal

The goal was to develop students' communication skills, leadership, and intrinsic motivation.

A two-part developmental program was included in the instruction. LDP assesses students' current levels in communication and team building. Activities introduced students to the two skill areas, as well as providing opportunities for growth. By the end of each cohort's instructional program, students completed a post-assessment of the two skills to ensure that they had achieved competency in each. The activities included:

(a) Introduction of LDP and facilitation of ongoing team building activities as an orientation.

(b) Introduction of communication and its role in leadership. Activities included student speeches, non-verbal vs. verbal communication, and pre-assessment of individual communication level.

(c) Introduction of team building and its role in leadership. Activities included group projects/assignments, strategies for working with a team, and pre-assessment of individual team building level.

(d) Students were given a post-assessment of all three skills. Eligible students were required to work on graduation ceremony presentations as well as an overall wrap-up of the skill set needed to success.

(e) Leadership Development Program Certificates were distributed to all the program participants upon graduation.

3.2 Measurable Achievement

100% of program participants qualified to receive a leadership certificate.

Figure 2. Leadership Development Program

IV. Pre-Engineering Transportation Program

4.1 Goal

The goal was to provide instruction on transportation, engineering, and infrastructure.

4.2 Academic Courses

Academic course work involved courses which were taught by CSU LA faculty and graduate students during the summer, fall, and spring semester of the 2019–2020 academic year. Whenever possible, instruction was project-based and involved hands-on activities such as designing and constructing activities.

Transportation Engineering Topics and Careers in the Transportation Field

The IATP students were introduced to a wide range of transportation activities in land, air, water, pipeline, and space transportation. The class provided the students with a broad range of intermodal transportation experiences with focuses on the environmental impacts of transportation systems, alternative fuel energy for transportation, and safety and security.

In order to show students how engineering applies to the world of transportation, they were shown a series of videos. The videos covered many topics including: types of jobs for transportation engineers, the past uses and future prospects of the field, and the importance of the industry. Students learned what it would be like if there were no transportation or traffic engineers and how they play a key role in our everyday lives. The videos also exposed students to career development within the field and the steps needed to obtain a job as a transportation engineer.

Transportation Safety and Security

The students were shown the importance of transportation safety and security. They were lectured to and further viewed an audio-visual module on the issue of transportation safety and security.

Mathematics and Physics

To aid the students in preparing for their California Standard Test (CST), they were given a geometry and trigonometry review. Faculty assisted the facilitators in conducting an informal quiz of their knowledge. Topics included congruent triangles, geometry proofs, parallel and perpendicular lines, triangle relationships, similarity, surface area, and basic trigonometry. Using CST practice questions released by the California Standardized Testing and Reporting (STAR) program, the students performed a self-assessment in order to be more adequately prepared for their upcoming tests.

IATP students also attended the lectures about fundamental of physics. The topics included kinematics (displacement, velocity, and acceleration) and dynamics (forces, Newton's laws of motion and applications to friction, drag, and elasticity). The students applied the above concepts in their popsicle stick bridges, pop-bottle rockets, and solar car projects.

Figure 3. Transportation Engineering Topics Sessions

Figure 4. Transportation Safety and Security Topics Session

Figure 5. Mathematics and Physics Topics Session

Microsoft Office Tools

Students received lessons in Microsoft Word, Excel, and PowerPoint. The Microsoft Word session focused on professionalism and in-office uses such as writing memos and reports. Students were instructed on how to use the proper fonts, use different formats for different types of documents, create references and citations, and review documents and make changes and

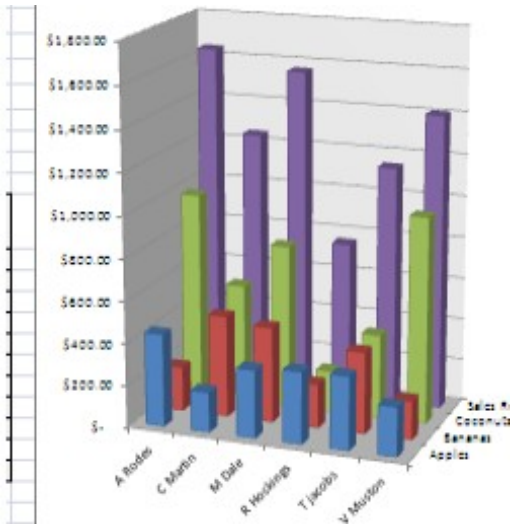
comments. After being taught the basic functions of Word, the students were assigned the task of writing a memo and professional email addressing certain topics and using proper formats.

During the Excel session, students learned how to format and manipulate cells, input data, utilize mathematical functions to analyze data, and input charts and graphs to enhance the functionality of their data. They used these skills to solve problems dealing with road design, traffic analysis, and budgeting.

The students were also learned the basic knowledge about Microsoft PowerPoint. They learned how to use basic functionality like importing pictures, hyperlinks, charts, and adding transitions as well as how to perform an actual presentation. They also learned the proper layout for a slide and what keeps the audience interested during a presentation.

The students were assigned to present on at least three different topics. They were taught Microsoft Office to prepare them for applications not only in college but also when they start working.

Figure 6. Microsoft Office Tools Session



Engineering and Technology Lab Tours and Presentations

IATP students went on several Civil, Mechanical, and Technology lab tours and attended related presentations at CSU LA. The tours allowed them to become familiar with the types of student projects in engineering and technology pursued at our campus. Many CSU LA staff and students were kind enough to give informational presentations that gave student participants a better understanding of what it meant to be in college.

Figure 7. ECST Lab Tours and Presentations

Cal State LA Hydrogen Station

The students visited the Hydrogen Research and Fueling Facility (H2 Station) at CSU LA. The facility has become the first station in California to be certified to sell hydrogen fuel to the public. "This is a milestone in the commercialization of hydrogen in preparation for the next generation of electric vehicles that will be powered by hydrogen," according to Michael Dray, technical operations manager at the fueling facility (CSULA, 2014). "It's equivalent to getting the first sticker from the state government to sell gasoline by the gallon." The hydrogen facility at CSU LA provides key research data on fueling performance and station operations to the U.S. Department of Energy and National Laboratories, as well as to State agencies such as the California Energy Commission and California Air Resources Board.

Figure 8. Visiting the Hydrogen Research and Fueling Facility at CSU LA


MESA and Cal State Los Angeles present Boeing Day and Open House

IATP students were able to attend Boeing Day that is held every year on the Cal State LA campus. It started with a brief introduction from the Dean of Engineering, Dr. Emily L. Allen, who motivated the thousands of kids to work hard to achieve their dreams in the world of science. The facilitators escorted all student attendees around the campus, and they attended various activities and workshops, such as:

- Careers Opportunities in Transportation by majoring in:
  - Electrical Engineering (Electric Vehicles), Dr. Charles Liu, CSU LA
  - Aviation, Dr. Rachel Friedman, CSU LA
  - Urban Sustainability, Drs. Gustavo Menezes & Pacheco Vega, CSU LA
  - Personal Statement Tips: Dr. Rebecca Joseph, CSU LA
- Tips on how the students can start building their college portfolio for college admission
- Personal Journey into Engineering: Boeing Professionals sharing their personal journey to working at Boeing
- Boeing panelist: Moses Escobar (Manager-767 Fleet Chief Office: Seal Beach), Diana Lopez (Manager Systems Engineering: Huntington Beach), Dalia Rhule (Project Manager: Long Beach), and Nathalie Vazquez (System Design Engineer: El Segundo)
- Design Expo: Building solar cars with a team, Chris Bachman, CS ULA
- Learning about teamwork and design of car to run on a dirt terrain and compete against other cars.

To further inspire IATP students to choose an engineering career path, they were invited to participate in a lab tour where they visited multiple labs at Cal State LA such as the eco-car laboratory.

Figure 9. Boeing Day at CSU LA

Student Projects

During the second phase of the IATP program, hands-on projects were developed to encourage the students to research and apply engineering knowledge. They also enabled the students to learn the steps involved in the research and development process, mainly research, theory, design, fabrication, testing, and analysis. First, the students explored conceptual questions relating to their project on the Internet, and they then gave a group presentation to their classmates on their findings. The physical principles and mathematical equations to build a scientific relationship to supplement project success were discussed. During this time, the students asked relevant questions to further learn about the theories.

The design process incorporated the use of principles and equations in relation to the scope of the project. The construction of models allowed students to build what they designed, giving them a hands-on experience to apply the concepts. Project testing occurred under a fixed set of conditions to determine the design effectiveness, and the students analyzed their designs to determine where improvements could have been made. Throughout the projects, the instructors discussed the engineering design process with the students.

Popsicle Sticks Bridge Project

IATP students received an introduction to civil and highway engineering through the popsicle stick bridge project. In a team of four, students researched, designed, constructed, and tested a model bridge made of popsicle sticks. First, students researched topics pertaining to this project. Using the research results, each team created a PowerPoint presentation on their findings and presented to all participants. The winners were selected and awarded with certificates. This activity helped the students improve leadership, teamwork, and presentation skills. Each team prepared several bridge designs. Students constructed their popsicle stick bridges according to their selected design. These bridges were tested in the popsicle stick bridge competition. Finally, each team used the competition's results to evaluate their bridge.

Figure 10. Introduction to the Popsicle Stick Bridge

Figure 11. Presentations and Fabrication of Popsicle Stick Bridges

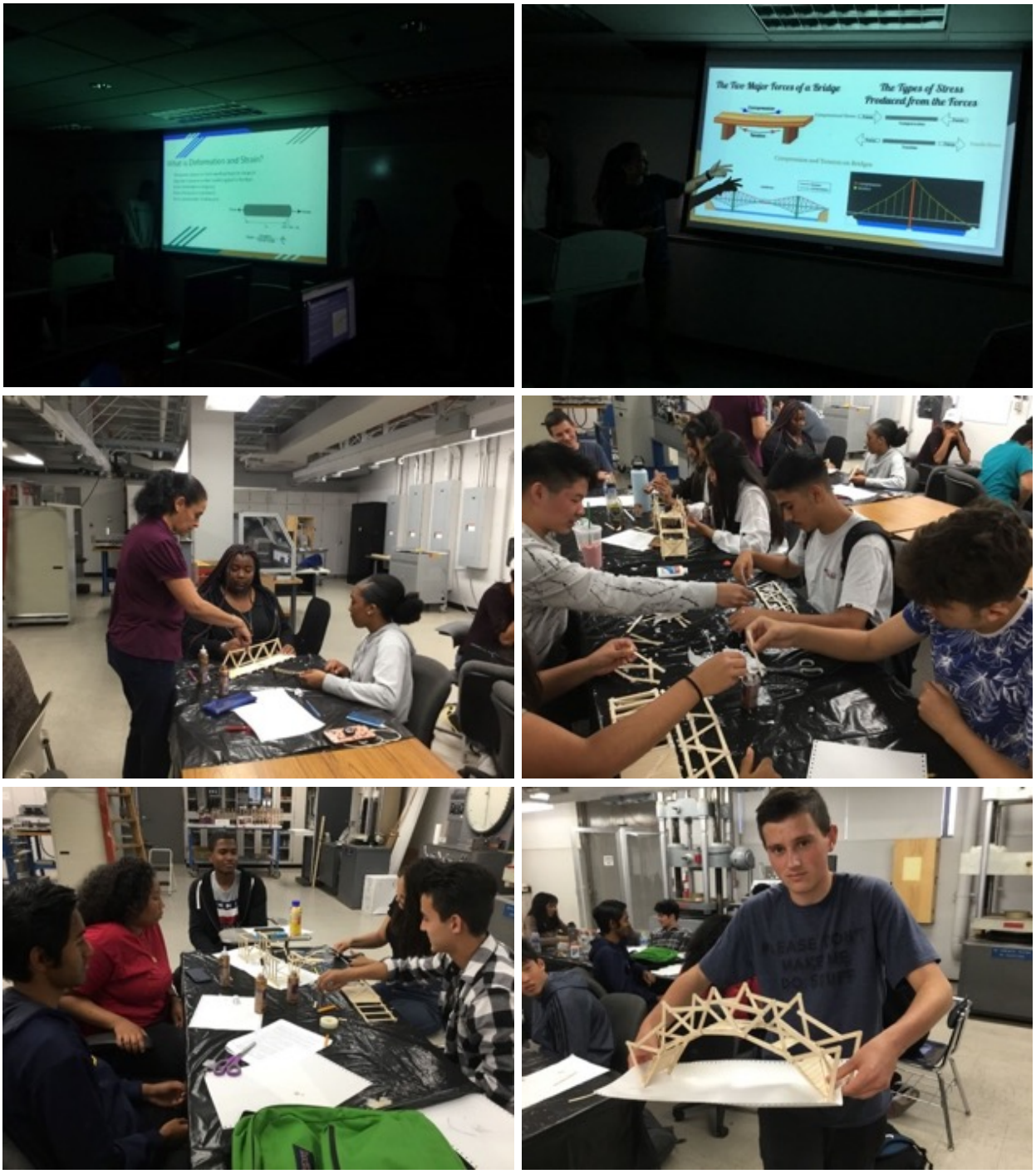
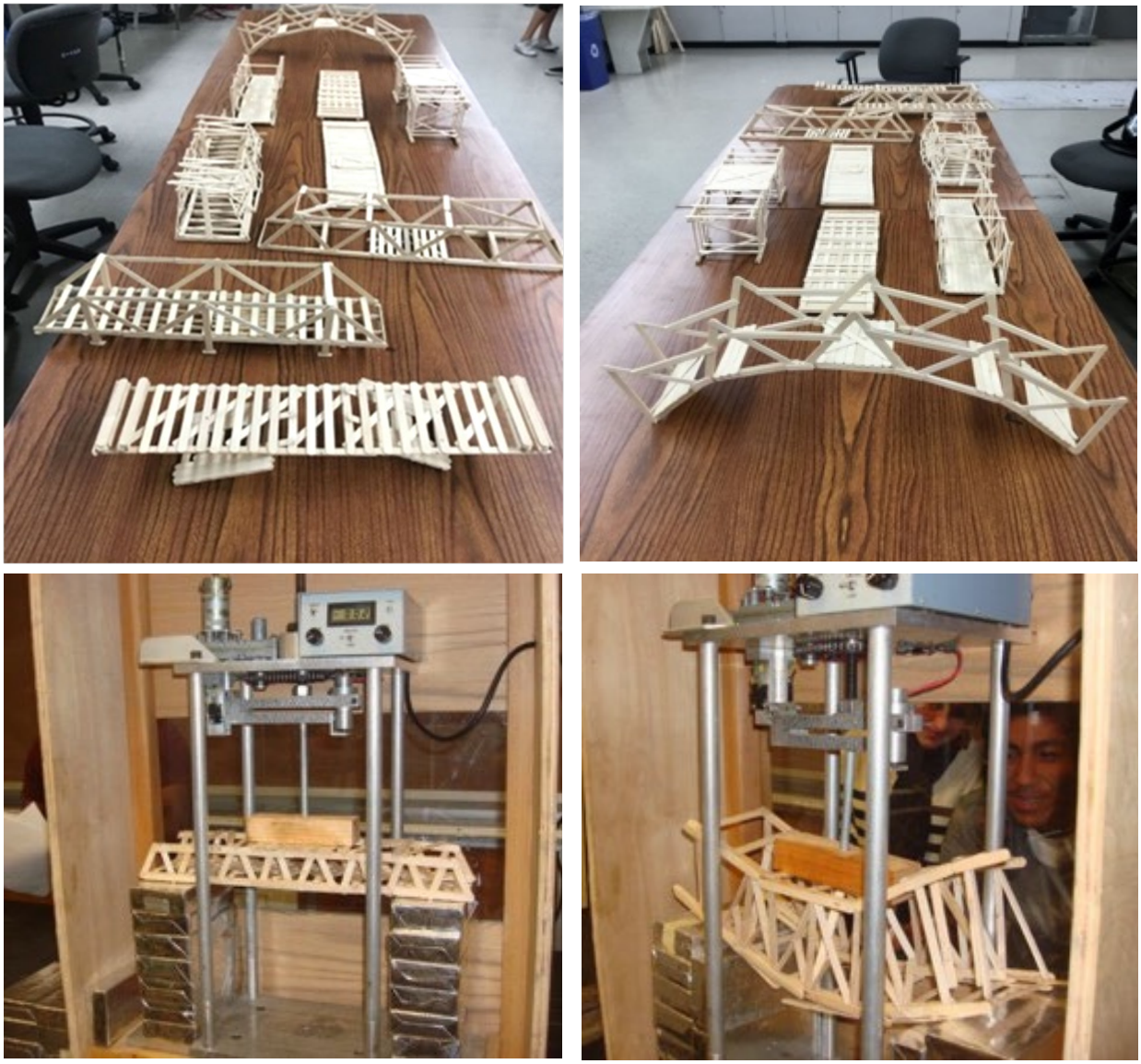


Figure 12. Construction and Testing of Popsicle Stick Bridge



Pop-Bottle Rocket Project

In this project, the class was broken up into teams of four students. Each student team researched, designed, constructed, and tested a hydro-pneumatic-propelled pop-bottle rocket vehicle. Students performed research for this project by answering research questions in basic physics, rocket history, and basic rocketry. Students presented their findings using PowerPoint software, and the student with the best presentation was awarded a certificate.

The design component of this project incorporates the use of formulas that relate to the principles of rocketry and the understanding of rocketry as a form of transportation. Construction of these

rockets consisted of readily available, low-cost materials. Testing of the student team designs included static and dynamic examinations. Written and oral reports were also submitted by students to chronicle the design, construction, and evaluation of the team submissions.

The competition, which took place between the student teams, was based on two main categories: rocket design and performance. The design category was based on the use of high-technology manufacturing methods and materials or creativity in the development and appearance of the rocket. The performance category was based on the results of static and dynamic examinations. These examinations included altitude attainment and flight stability.

Figure 13. Construction of Pop-Bottle Rocket

Figure 14. Testing of a Pop-Bottle Rocket Vehicle

Solar Eagle III Activity

The Solar Eagle III activity was proposed to the students in order to enhance their knowledge of alternative fuel energy sources and to create enthusiasm for the upcoming Solar-Powered Vehicle Project. During this activity, the Solar Eagle III solar-powered vehicle was presented to the students. The activity started with streaming the video about the design, construction, and the competition process for the Solar Eagle III. The vehicle was then demonstrated to the students to discuss and identify the structure and the components. The representative from the technology department at Cal State LA demonstrated the driving performance of the vehicle. Questions about the vehicle, the technology, and its implications for the environment were also discussed.

Figure 15. Demonstration of the Solar Eagle III

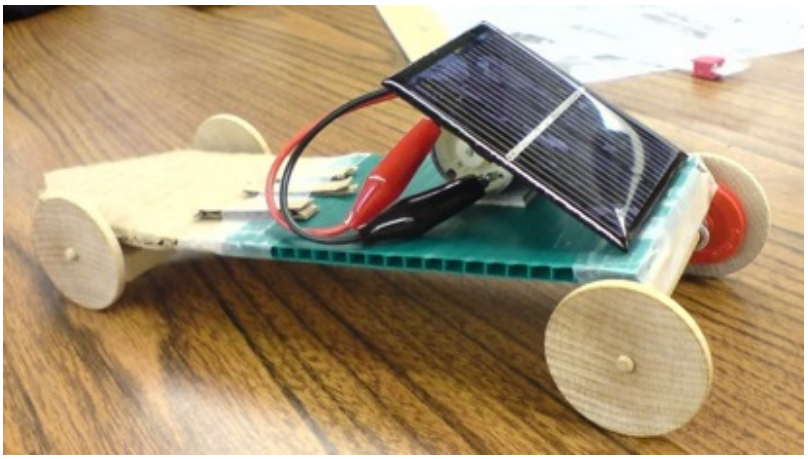
Solar-Powered Vehicle Project

Considering the success of solar-powered vehicles developed at Cal State LA, the IATP student teams designed, constructed, and tested their own solar-powered vehicles. The design component of this project incorporated the use of theories and formulas that relate to the principles of electricity, solar energy, and power transmission. Construction of these solar-powered vehicles used readily available, and low-cost materials. Testing of the student teams' designs included static and dynamic examinations. Written and oral reports were submitted to chronicle the design, construction, and evaluation of the student teams' solar-powered vehicle entries.

The objectives of this project/activity were to:

- Foster teamwork
- Evoke the spirit of competition
- Develop problem-solving skills
- Use mathematics to develop the design
- Apply theories and principles of solar energy and power transmission in a hands-on application
- Develop oral presentation and technical writing/reporting skills.

Figure 16. Testing the Solar Car and Installation of Engine and Solar Panel



4.3 Field Trips

Metropolitan Transportation Authority (MTA)

The IATP students went on several tours and presentations at MTA. The tours allowed them to become familiar with both the administrative and engineering infrastructure of MTA ("Metro"). The tours also provided insightful presentations into the industry and introduced them to the operations of Los Angeles public transportation. Many of the administrative staff and department heads delivered informational presentations that provided students a better understanding of what it meant to work as an engineer at MTA. They were also taken on "system ride-ins" tours during which they used different modes of public transportation including rail and bus. The students learned about the following topics:

- Bus Operation Division,
- Information Technology Division,
- Heavy and Light Rail Operation,
- Caltrans and LADOT Operations and Divisions,
- El Monte Transit Operation,
- Traction Power Division, and
- MTA Construction and Operation Sites.

In addition, students gained experienced on system design field work, transit-oriented development, and system cleanliness field work, as well as MTA safety policies and factors.

Figure 17. Tours and Presentations at LA Union Station and Metro, MTA

Figure 17. (continued from previous page)

Figure 18. Tours and Presentation of Bus Operation Center at MTA

Flabob Airport Visit

The IATP students went on tours and presentations at historical Flabob Airport. The tours allowed them to become familiar with career opportunities in aerospace/aviation and the transportation industry. The tour was also an adventure where students used flight simulators, and visited the aviation sites and the aircraft museum. This field visit was an exciting opportunity for students to learn about planning a flight, aviation history, the physics of flight, and the design and maintenance of aircraft. In addition, the students learned about the requirements involved in becoming a certified pilot and air traffic controller as well as the importance of making decisions that will influence their ability to enter these fields.

Figure 19. Air Transportation Presentation and Hands-On Project

Figure 20. Tours and Presentations at Aircraft Museum

Figure 20. (continued from previous page)

4.4 Internships and Career Placements

Goal

The goal was to provide internships and career placement within transportation agencies.

Students were exposed to various internship and job placement opportunities that focus on transportations services with collaborating partners such as LADOT and MTA. Because of a lack of space and safety requirements at LADOT and MTA, IATP students were given the opportunity to pursue a project-based internship on CSU LA campus under the guidance of LADOT, MTA, or CSU LA faculty members. IATP facilitators guided the students during several projects including design of earthwork, reading contour lines, computing earthwork quantities, and creating topographic maps with AutoCAD, as well as testing highway construction materials. The successful completion of the projects demanded creativity, collaboration, and ingenuity from each intern. The problem-solving and critical thinking skills that went into the design and execution of these projects was truly remarkable, and the students' pride in their achievement was a testament to how hard they worked to complete the complicated project they were given.

Measurable Achievement

A total of 28 students completed the internship portion of the IATP program. Each student received a stipend for their participation.

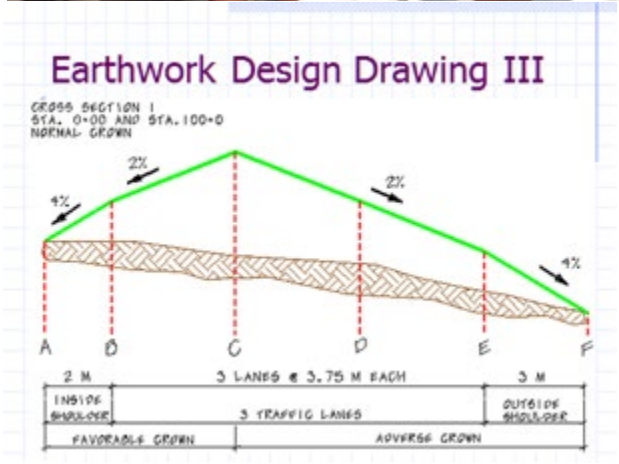
Design of Topographic Maps and Computing Earthwork Quantities

IATP students learned about the concept and design of topographic maps which describes the physical features of a piece of land. Students also learned about reading and designing contour lines which show the elevation changes of land. Furthermore, the students computed earthwork

quantities on a proposed roadway. In order to determine the roadway excavation and embankment, the grade line for the roadway was determined and cross sections made of the original ground. Earthwork quantities then were determined using a mass diagram.

Figure 21. Demonstration of Contour Maps

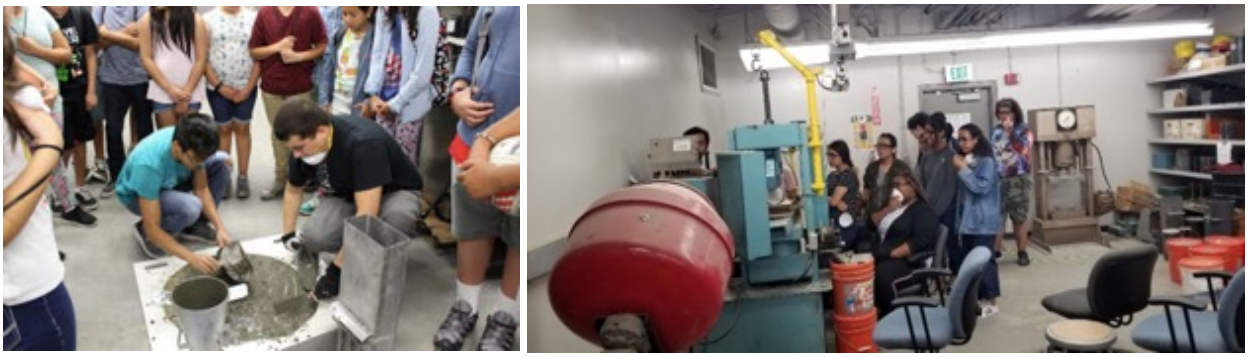
Figure 22. Design of Topographic Maps and Earthwork Quantity Estimations



Mixing and Testing Structural and Highway Construction Materials

IATP students visited the Civil Engineering Materials Laboratory at Cal State LA and learned about the basic concepts of structural materials testing in civil engineering. The group interacted with undergraduate and graduate students while they were performing various materials testing activities and preparing concrete samples in the lab. They learned about the components and basic concepts of making concrete materials as the most used type of construction material in the industry. The lab members discussed and explained the applications of concrete for underground transportation infrastructure as well as other transportation systems and buildings.

Figure 23. Performing Concrete Sample Tests in the CSU LA Lab



During this visit, the student group also learned about the student competitions and teams at CSU LA, such as the Concrete Canoe team, and how these CSU LA students are getting prepared for the regional competitions. Interacting with undergraduate and graduate students was a great experience for the group to learn about their future higher education path and it inspired their interest in the field of transportation engineering.

Figure 24. Showcasing the Concrete Canoe Team at CSU LA

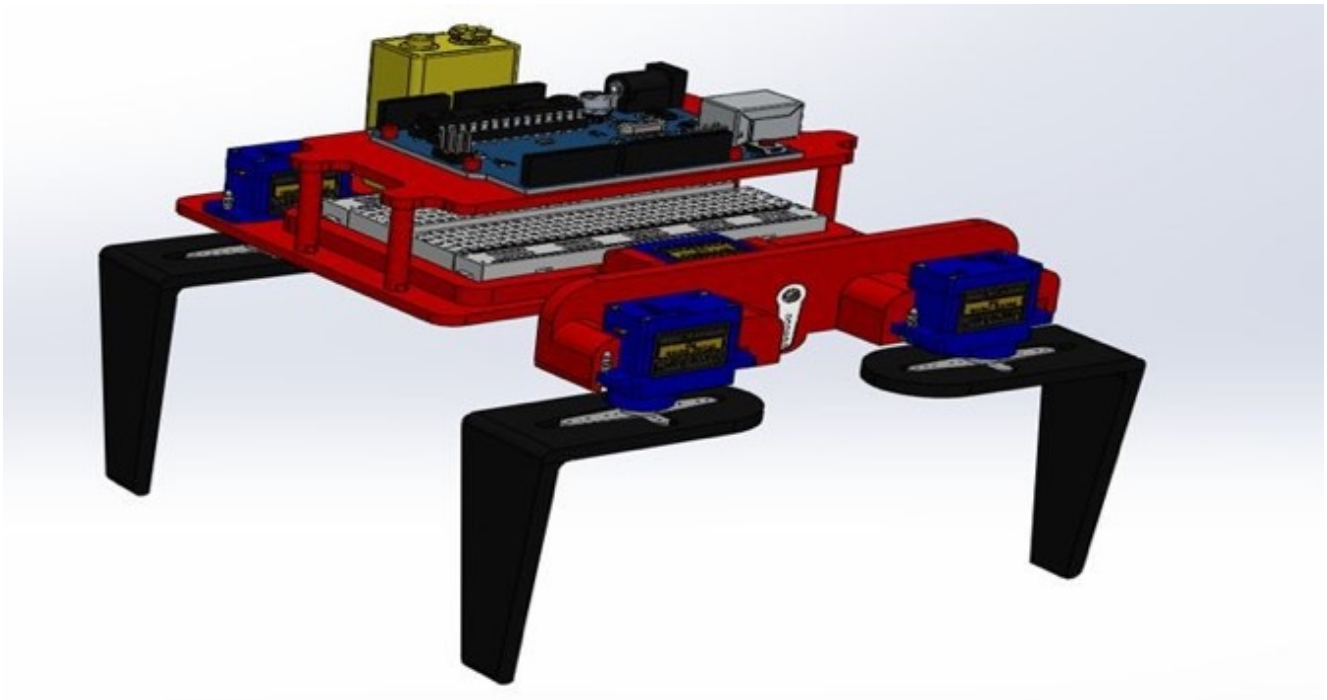
Robotics

IATP students learned about the concept of design and the important role it plays in making robots. Students also learned about the design of robots and used SolidWorks and a computer software packages to design and operate a robot. The facilitators demonstrated how the parts are made using SolidWorks, and also demonstrated what kinds of projects they can design at home through the use of different hardware.

In the robotic sessions, the students were introduced to the applications of robots in transportation and taught how to assemble a robot car kit. To get the students more involved in hands-on experience in robotics and teamwork, the students were divided into three groups and each group was given a robotics kit to work with. The students were first taught basic programming in Arduino. They made a small course on the floor for the student teams to try to follow with their cars. Each group would study the course, upload their own Arduino code to the Arduino Uno on the car, and move the motors using Pulse Width Modulation (PWM) and time delays. Through trial and error, all three teams were able to complete the course.

The students also built an application whereby the robot is able to walk with three degrees of freedom (forward, left, and right) by manipulating the servo angle values. The robot is then matched with the code that allow it to move.

Figure 25. Solid Work Design of a Robot



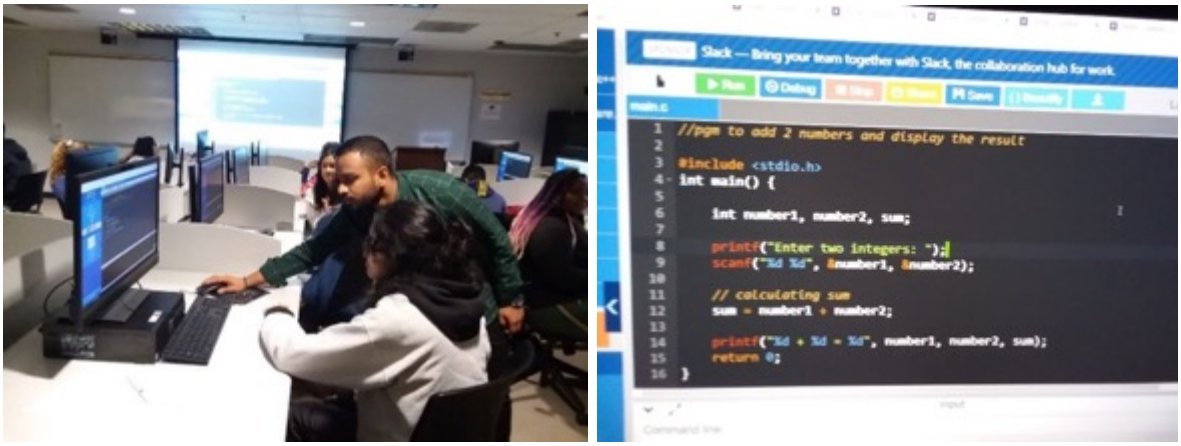
In addition, the students were each assigned a computer and introduced to a program called MIT App Inventor. They were taught basic app design using a drag and drop feature integrated in the program. Furthermore, the students were also introduced to the block system that the program provides. This block system allowed the students to establish connectivity from the app to the robot using its own piece of code and a Bluetooth module that they were provided with. Once all students completed their applications, we explained how the code that was provided allowed connectivity. Once all the students had finished their applications, we allowed them to test it by connecting to the robot and playing with it.

Figure 26. Application of Bluetooth in Design and Operation of Robots

Computer Activities

In this session, the faculty and student assistants introduced students to a variety of computer activities such as computer programming in the *C* language, and webpage design. *C* is a powerful general purpose programming language that can be used to develop software like operating systems, databases, compilers, and so on. *C* is an excellent language for beginners to learn to program.

Figure 27. C Language Programming Session



4.5 Job-Relevant Skills

Goal

The goal was to offer training in job-relevant skills including AutoCAD and SolidWorks software packages.

Workforce Readiness

During this program, a structured workforce readiness workshop was conducted to prepare students for applications to internships and jobs. The activities given during the workshops included topics on professionalism, getting a job, developing a resume and cover letter, and interviewing. Interested students applied to internship programs with agencies such as MTA and AECOM in Southern California.

Resume Writing and Critique

Students were instructed to create their resume before the start of the internship. Many students had no existing resume so they were instructed on formats and given information that they need. Students learned what type of leadership skills to list and what type of information does not need to be included. The purpose of the resume preparation module was to prepare students to apply

for jobs that will lead to their chosen career or profession. In addition to resume writing, the students were given tips on how to apply for jobs and were also prepped on possible interview questions, giving them more confidence to enter the professional world.

AutoCAD and SolidWorks Software Packages

Students received hands-on training in AutoCAD and SolidWorks software packages as well as in skills related to industry standards. Skill training included, but was not limited to, software programming, tool usage, technical training, and hands-on work projects. Activities included group presentations and teamwork.

AutoCAD Training Session

The initial phase of IATP began with an introduction to the multitude of uses for AutoCAD in various engineering disciplines. The students were taught basic program commands and editing tools that would later be applied to their design projects. Students learned the basics such as drawing lines and circles and how to input angles. To supplement their education, they also learned about dimensions, polylines, hatching, and more. The facilitators introduced the concept of viewing an object from different angles in 3D and drawing it in a 2D plane. By the end of the AutoCAD session, the students could construct floor plans, integrate given profile views into isometric blocks/shapes, and model bridges.

Figure 28. Design Project in AutoCAD

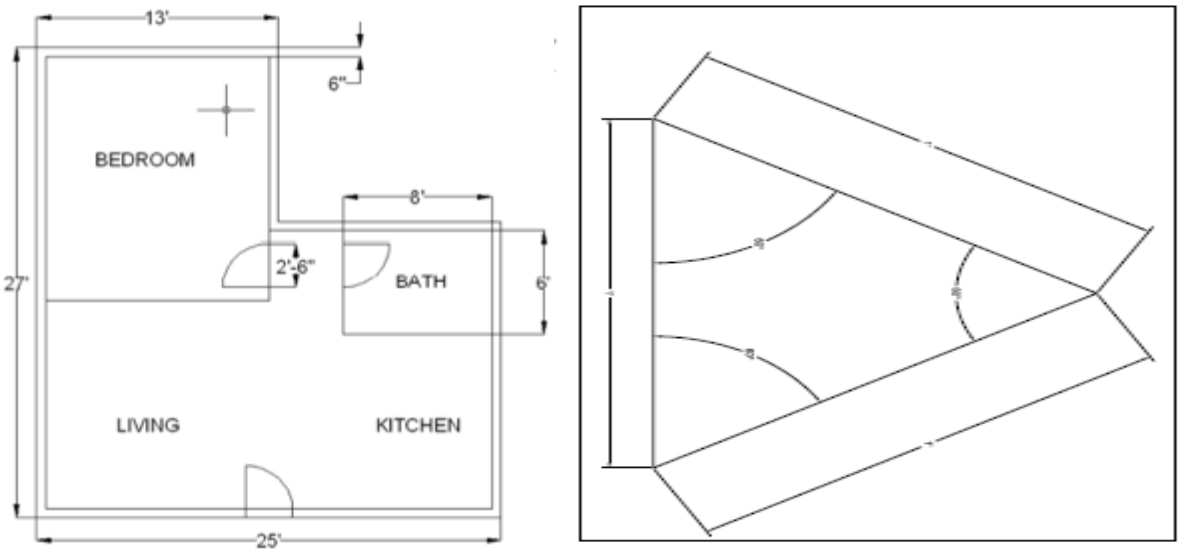


Figure 29. AutoCAD Design

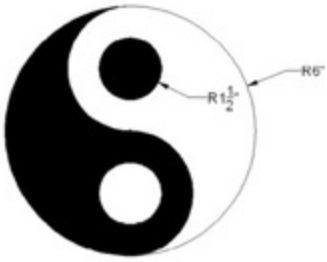
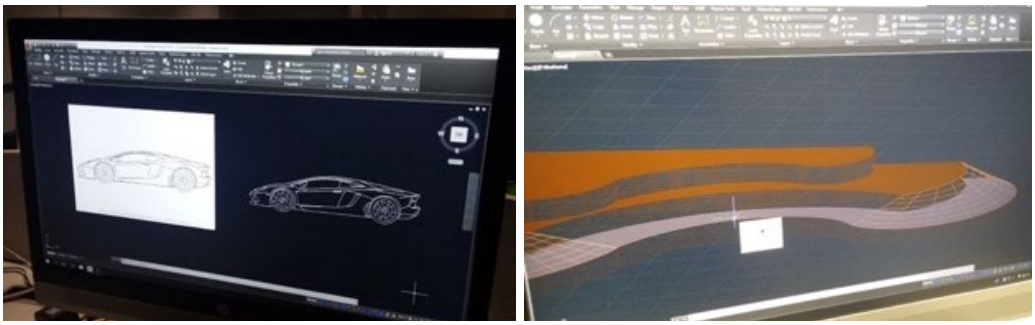


Figure 30. AutoCAD Session

Figure 31. AutoCAD Project

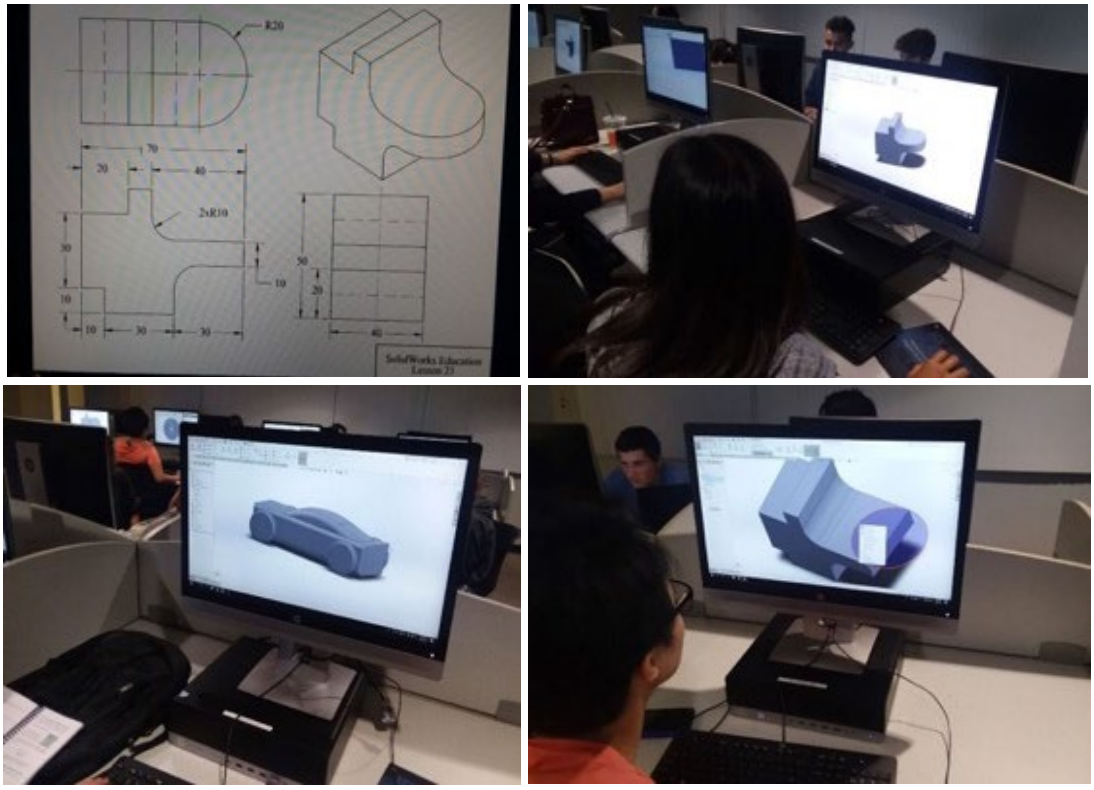


SolidWorks

The students were introduced to the multitude of uses for SolidWorks in various engineering disciplines. SolidWorks is a 3D mechanical CAD (computer-aided design) program The students were taught basic program commands and editing tools that would later be applied to their design projects. Similar to AutoCAD training session, students were taught how to draw and generate 3D renderings.

Figure 32. SolidWorks Session

Figure 33. SolidWorks Projects



Measurable Achievement

All program participants demonstrated mastery of both AutoCAD and SolidWorks software packages.

4.6 Orientation

IATP orientation was held at CSU LA On Thursday, June 27, 2019, between 9:00 a.m.–12:00 p.m. with a total of 76 students and parents. The project director welcomed the IATP students and their parents to the program and introduced the program facilitators. He presented the purpose of the IATP and an overview of the curriculum and schedule. He also explained the IATP objectives and the students' responsibilities and expectations within the program. The parents were informed of the campus location and time for signing in and out, supervision, insurance, and provisions in case of illness and injuries. At the end of the session, the facilitators gave students a tour of campus and showed the locations of student drop-off in the morning and pick-up in the afternoon.

Figure 34. IATP Orientation Session

Figure 35. Campus Tour at Orientation Day

4.7 Closing Ceremony

IATP ended with a graduation ceremony where family members could share in recognizing the effort invested by the students throughout the program. The event was held in the Golden Eagle ballroom at CSU LA. The ceremony consisted of various speakers congratulating students on their achievements and encouraging them to pursue a degree in engineering. Slideshows were created using photos taken over the duration of the program to outline the activities and projects that the students participated in.

During the closing ceremony, students were called up to the stage and given a certificate of graduation, acknowledging leadership skills gained. Selective awards were given to those who showed outstanding performance while working on the popsicle bridge and pop-bottle rocket projects. A few of these students were chosen to speak for their peers about their experiences. They spoke of the knowledge they gained and of all the people they would miss from the program.

Figure 36. Graduation Ceremony

V. Program Evaluation and Student Academic Progress

Student academic progress was monitored in order to assess the effectiveness of the program components. The evaluation process measured their scholastic performance, their ability to work in interdisciplinary teams, their communication and leadership skills, and overall, their preparedness to enter transportation-related careers.

Students also evaluated the academic programs and faculty, and the project director and faculty reviewed the course contents, student projects, and laboratory experiences on a weekly basis. Process and outcome evaluation data pertaining to the overall program were gathered from students and faculty and analyzed to measure the success of the program. Overall, the evaluation of academic modules and field trips were excellent as reflected by students' evaluations, comments, and letters. The Summary of Program Evaluation Forms (Table 3) also shows that the program was extremely successful.

Table 3. Summary of Program Evaluation Survey

Overall Program Evaluation	Av. Score (out of 4)	Score (%)
INSTRUCTORS		
The IATP instructors were well organized.	3.32	82.9%
I was academically challenged by the activities the instructors provided.	3.03	75.7%
The instructors responded well to the questions posed to them.	3.73	93.2%
STAFF		
The staff was very interested in my career awareness.	3.37	84.2%
The staff was very helpful when I had problems.	3.70	92.5%
The staff encouraged students to strive for excellence in all their pursuits.	3.85	96.2%
The staff was always available when I had a question or needed assistance.	3.68	92.1%
The staff was very friendly at all times.	3.78	94.5%
The staff was very knowledgeable on transportation-related careers.	3.75	93.8%
The staff was very enthusiastic about transportation-related careers.	3.78	94.5%
ACTIVITIES		
Project activities helped me understand transportation careers better than before.	3.41	85.3%
Generally, adequate time was allotted for project activities.	3.45	86.3%
Generally, adequate time was allotted for audience participation.	3.51	87.7%
Project activities gave me some practical experience related to transportation.	3.52	88.0%
Generally, adequate time was allotted for audience participation.	3.51	87.7%
Project activities often included competition between groups.	3.93	98.3%
OTHER		
The internship was appropriate.	3.82	95.5%
The number of field trips in the internship was appropriate.	3.40	84.9%
The number of projects was appropriate.	3.55	88.7%
Enhancement activities were beneficial.	3.58	89.4%
The number of days in the internship was appropriate.	3.49	87.3%
The IATP was effective in my future career planning.	3.63	90.8%

VI. Final Summary

The IATP workshops sparked students' creativity and inspired them to view the transportation industry in a new light. The students have been well served by the partnership with several transportation agencies and they will be able to benefit from the skills they have acquired through the program as they pursue their educational and career goals.

The Infrastructure Academy Transportation Program's workshops succeeded in providing the students with exposure to several areas related to STEM and the transportation industry such as engineering principles, transportation engineering, leadership skills, AutoCAD, SolidWorks, and computer software packages.

The internship component of the program was equally successful. The students obtained valuable experience and had various accomplishments. By participating in this program the students were able to apply principles learned in the workshops to real-world problems that prepared them for entry into the workforce.

CSU LA is a federally designated minority institution situated in a service area primarily populated by a low-income and underrepresented minorities community. This project has recruited students from the above community who plan to enter college to study STEM and pursue careers in engineering field as well as directly enter the transportation workforce.

About the Author

Hassan Hashemian, PhD

Dr. Hashemian has been a professor of Civil Engineering at California State University, Los Angeles for forty years. He has been teaching undergraduate and graduate courses in transportation and traffic engineering, transportation planning, traffic flow analysis, engineering economics, and probability and statistics. In addition, Dr. Hashemian has extensive experience managing federal and State-funded research and training programs. In the past thirty years, he has managed over 32 training programs and 35 research and consulting projects. He has also demonstrated success in many outreach projects including the Infrastructure Academy Transportation Program, the Summer Transportation Institute, the Garrett Morgan Education Program, and the Dwight D. Eisenhower Fellowship program. Dr. Hashemian is a highly respected educator. On January 11, 2018, at the Transportation Research Board meeting in Washington, D.C., he received the FHWA public service award for his outstanding dedication, leadership, and contributions to advancing transportation education, research, and workforce development. He has won a number of other awards for research and teaching, including the Exemplary Achievement Award from Secretary of Transportation Mr. Rodney Slater in 1988, ITE in 1995, FHWA in 2001 and 2002, and the Outstanding Professor Award at CSU LA in 2006, 2007, and 2012. Dr. Hashemian has presented several technical papers at international and national conferences focusing on transportation engineering. For the present project, Dr. Hashemian was responsible for the academic leadership of the program, including the selection of instructors, academic assessments, and teaching. He was also responsible for implementing the statement of work according to the funding requirements of the MTI. Dr. Hashemian received his BS and MS from University of Wisconsin, Madison, and his PhD from University of California, Berkeley.

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