



YEAR FOUR

SUMMATIVE EXTERNAL EVALUATION REPORT

EDUCATING ADVANCED DRIVER
ASSISTANCE SYSTEMS TECHNICIANS
JUNE 2024

Table of Contents

Citation	4
Overview	5
Broader Impacts	6
Intellectual Merit	7
Program Goals and Objectives	7
Table 1: ADAS Tech Goals and Objectives	8
Evaluation Methods	9
Data Collection	9
Data Mining Workbook	9
Evaluation Questions	10
Table 2: Goals, Evaluation Questions, Activities, and Deliverables	10
Results	11
Table 3: Modified and Newly Created Courses and Descriptions	12
Table 4: ADAS BILT Advisory Board Members	13
Figure 1: ADAS BILT Advisory Team Meetings	14
Table 5: Students' Demographic Information and Automotive Programs	15
Table 6: Female and Underrepresented Students' Demographic Information for Automotive Programs	16
Figure 2: ADAS Course Enrollment for Female and Underrepresented Population	16
Table 7: ADAS Equipment Purchase List	17
Table 8: Intellectual Competencies of Courses	18
Table 9: Incumbent Workers Demographics Table	19
Figure 3: Pre-Post Scores for Incumbent Workers	20
Table 10: Paired Samples T-test Results of Test Scores Table	21
Figure 4: Average Self-Efficacy Scores by Questions	22
Table 11: Promoting Career Pathway Awareness Activities	23
Table 12: STEM Teachers Event Focusing on ADAS Technology Agenda	23
Table 13: Descriptive Table for Pre- and Post-Survey Results for Teachers' Event	25
Figure 5: Mean Error Plot of Test Scores Pre- and Post-Survey Scores	25
Table 14: Promoting Career Pathway Awareness Activities	26

Discussions	28
Recommendations	30
Summary	31
References	32



Citation

Shen, Z., Blackmon, A.T., Calistro, T., & Correa, K (2024, June). Educating Advancing Driver Assistance Systems Technicians: Year Four Formative Evaluation Report. Atlanta, GA, Innovative Learning Center, LLC. Grant No. 2000618
<https://doi.org/10.52012/XCLK3756>

Introduction

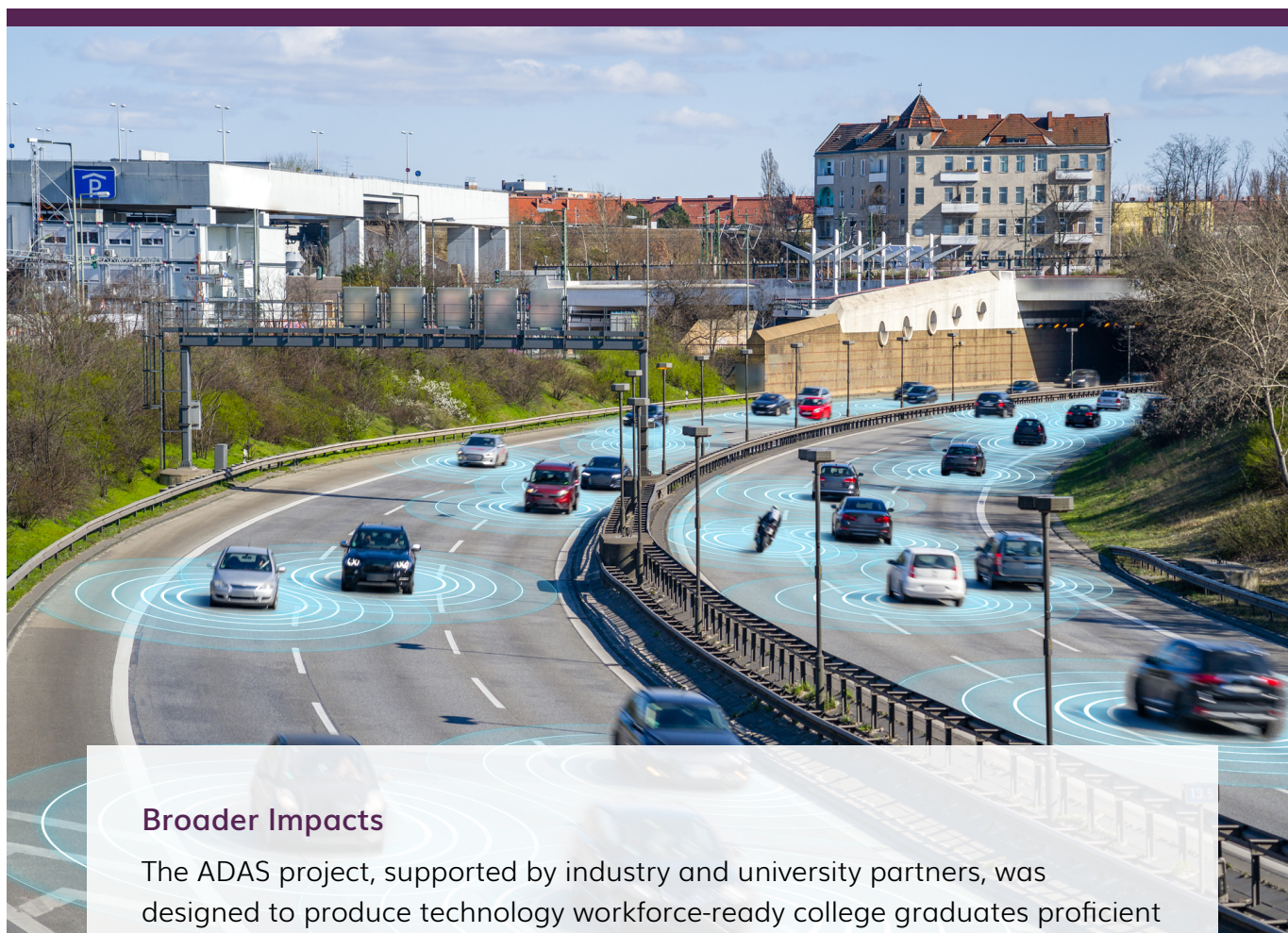
Autonomous cars and intelligent vehicles are no longer science fiction. They are increasingly becoming part of our everyday lives. Advances in autonomous vehicles promise to improve our quality of life by enhancing safety, reducing traffic congestion, and offering more efficient fuel consumption (Bagloee et al., 2016). With increasing technological advances in the automotive industry, we may soon be able to replace time spent driving with time volunteering in our local communities or schools. Eventually, we may even have opportunities to work during our commute to the office, thus increasing the time available for outdoor activities within our natural environments.

Technological advancements in safety associated with autonomous automobiles may also significantly reduce automotive-related injuries and fatalities. All these promising outcomes have been driving innovation forward so much that by 2030, 12% of new cars will have autonomous technologies, and by 2035, 40% will have advanced autonomous driving technologies (Deichmann, 2023).

With advancements in autonomous and intelligent vehicles, their repair and maintenance complexity continue to increase. Specialty repairs and maintenance are needed for the cameras, displays, radars, sensors, computing systems, etc. As more and more cars become equipped with Advanced Driver Assistance Systems (ADAS), the need for complex repairs and maintenance associated with ADAS will also increase (Kaur et al., 2017). Soon, highly specialized mechanics and technicians will be needed at all repair shops as ADAS systems are becoming increasingly common in even entry-level vehicles.

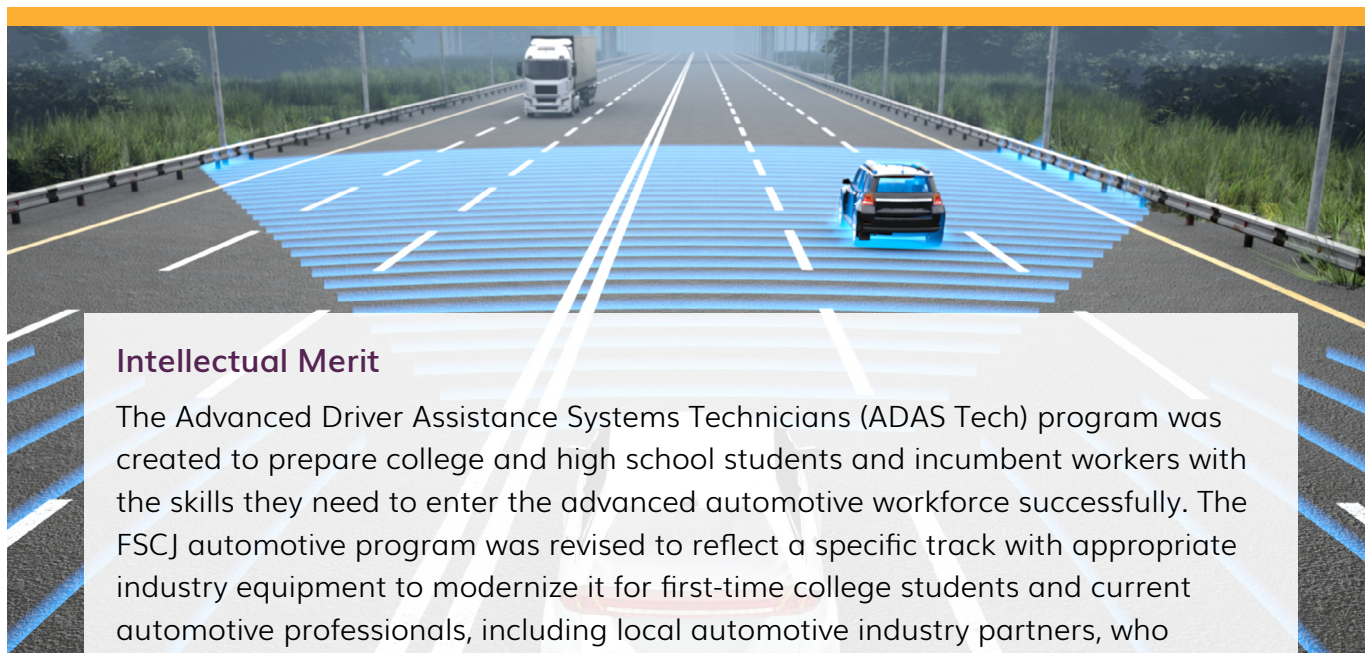
A highly specialized workforce will be needed to meet the demand for specialized repairs and maintenance for automobiles equipped with ADAS. ADAS Technicians (ADAS Tech) understand and apply science, engineering, and mathematics concepts to ADAS systems. Further, community college faculty use scientific methods and analytical skills to teach community college and high school students and incumbent workers to repair and maintain these advanced technologies within automobiles. Before funding the ADAS Tech program, Florida State College at Jacksonville (FSCJ) had limited coursework addressing automation with ADAS. The ADAS Tech program, which provides community college students with ADAS knowledge and skills, was implemented to prepare college students for the new automotive workforce.

A highly specialized workforce will be needed to meet the demand for specialized repairs and maintenance for automobiles equipped with ADAS.



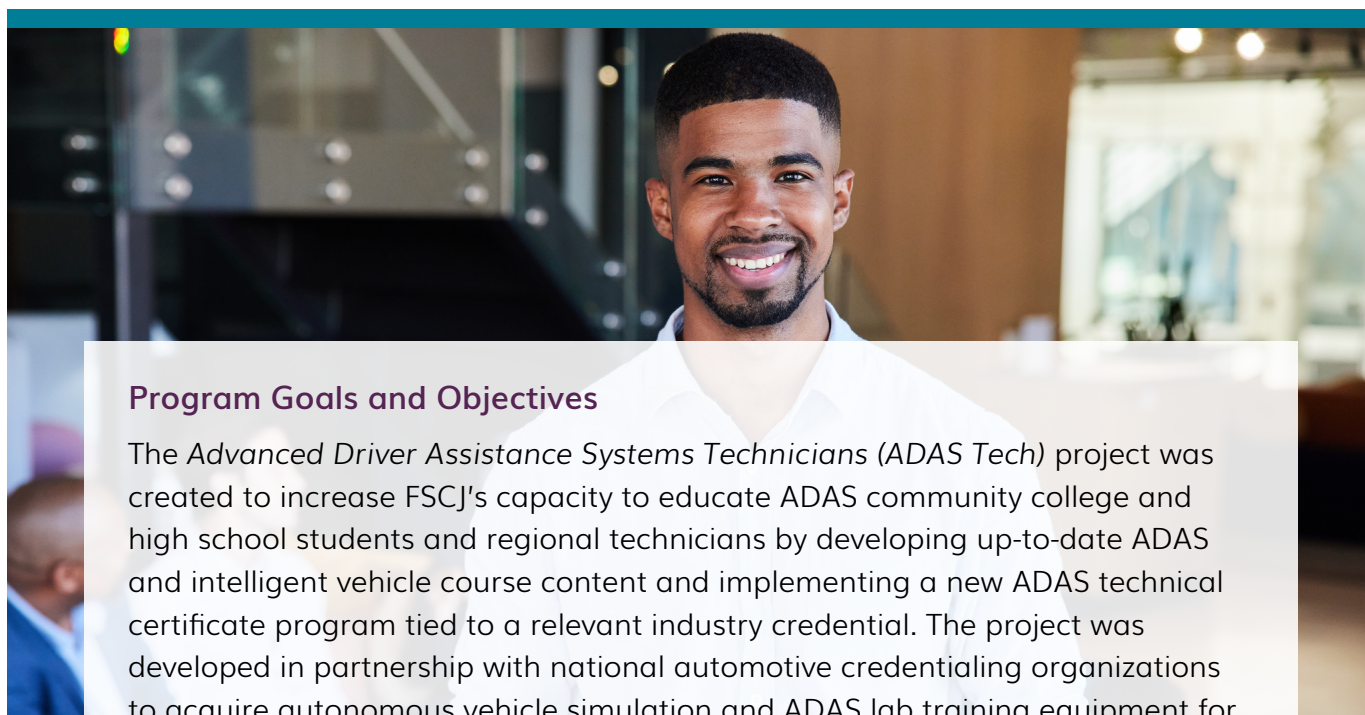
Broader Impacts

The ADAS project, supported by industry and university partners, was designed to produce technology workforce-ready college graduates proficient in Advanced Driver Assistance System (ADAS) principles, including ultrasonic sensor technology, schematics, measurements, and communication systems for both in-vehicle networks and Vehicle2X, which enables wireless, bi-directional communication between vehicles, pedestrians, buildings, traffic signals, and more. Over the past four years, industry partners have worked closely with the ADAS Tech Principal Investigators to create innovative traditional and hybrid curriculum modules and instructional strategies centered on ADAS competencies and teaching skills. Further, the project's PI has disseminated project outcomes widely. For instance, Professor Paul Soar, PI, presented ADAS and autonomous tech advancements at the ATE Conference and FSCJ Spring Division Meeting. He focused on education shifts, training pathways, and best practices in ADAS and AI, highlighting advancements and the transportation industry's move towards autonomous technologies.



Intellectual Merit

The Advanced Driver Assistance Systems Technicians (ADAS Tech) program was created to prepare college and high school students and incumbent workers with the skills they need to enter the advanced automotive workforce successfully. The FSCJ automotive program was revised to reflect a specific track with appropriate industry equipment to modernize it for first-time college students and current automotive professionals, including local automotive industry partners, who wanted to acquire new skills through college course offerings. The ADAS hybrid and face-to-face courses allowed participants to create a convenient schedule and self-paced learning.



Program Goals and Objectives

The *Advanced Driver Assistance Systems Technicians (ADAS Tech)* project was created to increase FSCJ's capacity to educate ADAS community college and high school students and regional technicians by developing up-to-date ADAS and intelligent vehicle course content and implementing a new ADAS technical certificate program tied to a relevant industry credential. The project was developed in partnership with national automotive credentialing organizations to acquire autonomous vehicle simulation and ADAS lab training equipment for FSCJ students and regional technicians. Intelligent vehicle diagnostic trainers and autonomous vehicle mini labs were purchased to provide underrepresented students with challenging and engaging applied science, engineering, and technology curricula. The equipment was also purchased to offer professional development for postsecondary and high school teachers.

Program Goals and Objectives

The *Advanced Driver Assistance Systems Technicians (ADAS Tech)* project was created to increase FSCJ's capacity to educate ADAS community college and high school students and regional technicians by developing up-to-date ADAS and intelligent vehicle course content and implementing a new ADAS technical certificate program tied to a relevant industry credential.

Table 1: ADAS Tech Goals and Objectives

Goals	Objectives
Goal 1: Develop, modify, and create course curricula modules for an Advanced Driver Assistance Systems (ADAS) technical certificate in the FSCJ Automotive Service Management Technology associate degree program.	Objective 1.1: Modify five courses and develop two new courses starting in Year 1. Objective 1.2: Formalize the ADAS Tech Business & Industry Leadership (BILT) Team. Objective 1.3: Work with ASE, NC3, SAE International, and the Connected Vehicle Trade Association to develop an ADAS industry certification. Objective 1.4: Recruit and enroll 40 students in the ADAS courses by the end of the project period. Objective 1.5: Launch the 5 modified courses and 2 new courses. Objective 1.6: Increase enrollment of underrepresented populations by 5 percent per year during Years 2 and 3, specifically focusing on women and students from under-represented populations, to create a diverse technician workforce.
Goal 2: Establish Autonomous Vehicle simulation and ADAS lab training equipment for students to practice applied skills.	Objective 2.1: Following purchasing and procurement procedures, acquire simulation equipment in Year 1, including the 2019 Toyota. Objective 2.2: Complete face-to-face faculty and simulation lab coordinator training workshops in Years 1 & 2 with in-service, ongoing training, and professional development offered throughout the project. Objective 2.3: Train 10 faculty members on equipment throughout the project. Objective 2.4: Provide learning experiences for 20 professional incumbent workers.
Goal 3: Promote career pathway awareness and strengthen mathematics and science skills for 40 high school students from underrepresented groups in the automotive industry.	Objective 3.1: Hosted multiple career exploration events with hundreds of high school students to explore ADAS technology and career ladders for employment with ADAS technology. Objective 3.2: Adapt ADAS technology education curriculum for face-to-face faculty workshops implemented in Years 2 and 3 to align with the content needs of high school teachers. Objective 3.3: Develop a career ladder that will articulate high school dual-enrollment credit into automotive technology associate degree programs at FSCJ, increasing the career ladder partnership with one local high school.

Evaluation Methods

Data analysts at the Innovative Learning Center (ILC) Division of Research and Evaluation evaluated the Advanced Driver Assistance Systems Technicians (ADAS Tech) program at Florida State College at Jacksonville (FSCJ). The evaluation assessed the program's effectiveness in meeting its goals and objectives. The evaluation employed a mixed-methods approach, integrating quantitative and qualitative data collection and analysis to report the program's impact comprehensively. Data were analyzed using descriptive and inferential statistics to identify trends, patterns, and significant differences. Data analysts coded and thematically analyzed qualitative data from surveys, documentation, and meeting transcripts to extract key insights and themes. For instance, evaluation analysts coded students' demographic information to present the project's efficacy and improvement related to increasing the engagement of underrepresented populations in ADAS technologies.

The evaluation findings were synthesized to assess the program's impact and recommend future improvements comprehensively. By employing a rigorous and multifaceted evaluation methodology, this summative external evaluation report thoroughly assesses the ADAS Tech program's effectiveness in advancing STEM education and preparing students for careers in the automotive industry.

Data Collection

The evaluation team collected data through meeting transcripts, documents, and a data mining workbook. The evaluation team populated the data mining workbook to structure information extracted from transcripts and documents (e.g., curriculum proposals, meeting agendas, committee meeting transcripts, and diary notes of programming activities). The data mining workbook aided the evaluation team in deconstructing documents to analyze the project team's progress toward the goals and objectives mentioned in the funded proposal. The data mining workbook allowed the evaluation team to see the alignment of proposed and executed activities.

Data Mining Workbook

The Data Mining Workbook is a resource that ILC analysts use to collect data from program teams unobtrusively. It is a shared workbook between ILC and the ADAS program team, which contains individual sheets on distinct aspects of the program. The Data Mining Workbook is ILC's innovative approach to program evaluation and is used to gather program information in one place. The ILC Principal Evaluator and Analysts enter program information into this shared workbook. This information is considered the "data" for program evaluation. Unique program data gathered includes a list of industry partners, BILT Advisory Board members, BILT Advisory Board meetings, student demographics, course descriptions, college faculty training, course credits, equipment purchases, certifications, dual enrollment activities, high school outreach, and other programming activities.

Evaluation Questions

The evaluation of the ADAS Tech program focused on several key questions, as outlined in Table 2. Analysts wrote questions to evaluate the effectiveness of course modifications and new course development in meeting learning outcomes and to gather feedback from students and faculty on these courses. The evaluation also explored the contributions of the ADAS Tech Business and Industry Leadership Team (BILT) in aligning course content with industry needs and determining the impact of collaborating with industry organizations on developing an ADAS industry certification. Additionally, the evaluation investigated the program's success in recruiting and enrolling 40 students in the ADAS courses, acquiring and using simulation equipment, and training faculty members on new equipment. Evaluation analysts also assessed the impact of professional development experiences provided to incumbent workers. Furthermore, the evaluation looked into how effectively college faculty adapted the ADAS curriculum for high school teachers and evaluated the success of developing a career ladder that articulates high school dual-enrollment credit into FSCJ's automotive technology associate degree programs.

Table 2: Goals, Evaluation Questions, Activities, and Deliverables

Goals	Evaluation Questions	Evaluation Activities and Deliverables
Goal 1: Course Development and Modification	How effective were the modifications of the five existing courses and the development of the two new courses in meeting the learning outcomes related to ADAS?	Documents (meeting notes, course syllabi, assessment items).
Goal 1: Industry Collaboration	How effectively has the ADAS Tech Business & Industry Leadership (BILT) Team contributed to the course content and alignment with industry needs?	BILT meeting transcripts, meeting agenda, attendance, and course documentation analysis.
Goal 1: Student Enrollment	To what extent has the program succeeded in recruiting and enrolling 40 students in the ADAS courses by the end of the project period?	Registered students' demographic information.
Goal 2: Faculty training	How many faculty members have been trained on new equipment?	Faculty training events documentation, laboratory equipment and device purchase notes, and meeting notes.
Goal 2: Professional Development	How have the learning experiences provided to the 20 professional incumbent workers impacted their skills and knowledge in ADAS?	Incumbent workers' training survey
Goal 3: Curriculum Adaptation	How effectively has the ADAS technology education curriculum been adapted for high school teachers in face-to-face workshops?	Surveys for high school teachers' workshop events.
Goal 3: Career Pathways	How successful has the program been in developing and implementing a career ladder that articulates high school dual-enrollment credit into the automotive technology associate degree programs at FSCJ?	Meeting notes, career ladder development documentation.

Results

The result section is organized according to the sequence of the ADAS project goals and objectives. **Goal 1 was to develop, modify, and create course curricula modules for an Advanced Driver Assistance Systems (ADAS) technical certificate in the FSCJ Automotive Service Management Technology associate degree program.** The Content Development Team (CDT), composed of manufacturing faculty members and industry experts (see Table 4), played a crucial role in creating courses and developing curricular proposals. The process undertaken by the CDT featured a review of courses. Course reviews were essential to gauge whether the program's objectives were fulfilled, verify that the course materials aligned with academic and industry benchmarks, and ensure hands-on and technical knowledge to ensure students were well-prepared for the workforce. The development of new courses was strategically focused on equipping students with skills and expertise, from foundational to advanced levels, to facilitate a smooth transition into the industry. During the course development phase, subject matter experts, faculty, staff, instructional designers, administrators, and curriculum coordinators reviewed the curriculum proposal to ensure that the course content aligned with the course objectives indicated by the Florida state framework.

Based on **Objective 1.1, the ADAS team aimed to modify five courses and develop two new courses starting in Year 1 reflective of newly acquired tools and equipment in coordination with industry partners and existing ATE PIs; and Objective 1.5 stated that the program would launch the 5 modified courses and 2 new courses.** Table 3 shows that these new and modified courses cover various essential ADAS topics, including autonomous systems, wireless technology, advanced driver assistance systems, automotive technology basics, steering and suspension systems, brake systems, and electrical systems. The courses were developed and modified in coordination with industry partners to ensure they reflect the latest tools, equipment, and industry standards. Collaborating with industry partners ensured the curriculum was up-to-date and relevant, preparing students with the skills needed in the evolving automotive industry. Based on the analysis of the industry collaboration and the way they collaborated with the CDT to create and modify courses; Objective 1.1 has been met.



Table 3: Modified and Newly Created Courses and Descriptions

Course Number	Course Status	Course Title	Topics	Credit Hours	Faculty Name	Class Size	Implementation Date
AER1425	New	The Connected Car: Autonomous Systems and Diagnosis	Connected and autonomous vehicle; wireless technology, systems, standards, and organization; Wireless networking and applications.	3	Paul Soar and Steven McCauley	20	Fall 2022
AER1420C	New	Advanced Driver Assistance Systems (ADAS) and Diagnosis	Advanced driver assistance systems (ADAS) and diagnosis; Active and passive sensor technology.	4	Paul Soar and Steven McCauley	20	Fall 2022
AER1081C	Modified	Introduction to Automotive Technology	Automotive industry; Basic service on tires, lubrication, wheel balancing, and vehicle inspections.	4	Paul Soar	20	Fall 2021
AER1498C	Modified	Steering and Suspension	Entry-level skills in the service and repair of steering and suspension systems, power steering, wheels, and tires.	4	Steven McCauley	20	Fall 2021
AER1598C	Modified	Brake Systems	Job entry skills in the theory, operation, and repair of brake systems.	4	Dr. Steve McCauley	20	Winter 2020
AER1694C	Modified	Electrical Systems I	Entry-level skills in automotive electricity and electronics technology.	4	Dr. Robert Wechsler	20	Winter 2020
AER2695C	Modified	Electrical Systems II	Electrical Systems I is designed to teach automotive electricity and electronics technology skills.	4	Dr. Robert Wechsler	20	Winter 2020

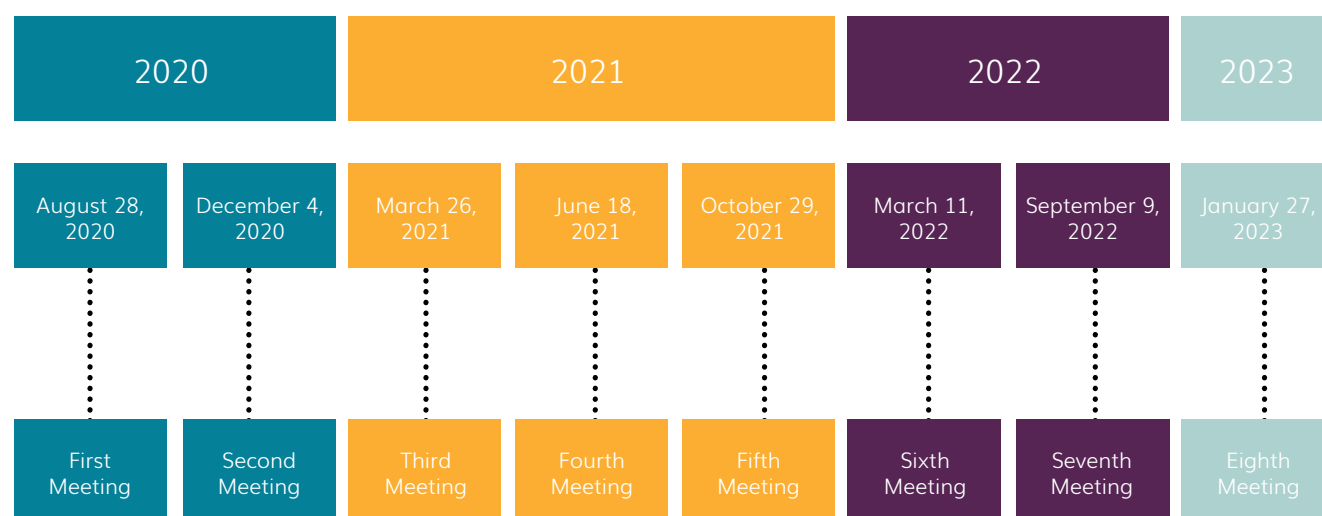
Objective 1.2 states that the project would formalize the ADAS Tech Business and Industry Leadership (BILT) Team to help in continuing to produce a job skills analysis and identify industry skills and knowledge. Table 4 demonstrates the robust collaboration between FSCJ and industry leaders through the formation of the Business and Industry Leadership Team (BILT). The BILT includes representatives from various sectors of the automotive and transportation industries, ensuring that the course modifications and new developments are aligned with industry needs and standards. The diverse expertise of the BILT members contributed significantly to the curriculum development and ensured that the new and modified courses were reflective of current industry practices and technologies.

Table 5 lists the regular meetings held by the BILT advisory team. These meetings were crucial for reviewing and refining the course content and ensuring that the curriculum updates were coordinated with the latest industry trends and requirements. The frequency and regularity of these meetings illustrate industry partners' continuous and proactive engagement in the curriculum development process. By leveraging the expertise and guidance of the BILT members and maintaining regular advisory meetings, FSCJ effectively aligned its course modifications and new developments with industry standards, thereby fulfilling Objective 1.2. This collaboration ensured that the curriculum was updated to reflect newly acquired tools and equipment, providing students with relevant and practical knowledge and skills in Advanced Driver Assistance Systems (ADAS).

Table 4: ADAS BILT Advisory Board Members

Last Name	First Name	Company Name	Company Title	Company Address	Company State	Zip Code
Fazier	William	JTA	Director of Automation and Quality Assurance	100 LaVilla Center Drive	Florida	32204
Olsen	Chuck	Air Pro Diagnostics	Sr VP of Automotive Technology Solution	11737 Central Pkwy	Florida	32224
McFarlin	Josh	Air Pro Diagnostics	Executive VP Operations	11737 Central Pkwy	Florida	32224
Sandifer	Alex	Southeast Toyota Distributors	Manager, Technical Training and product support	Jim Moran Blvd	Florida	33442
Newsome	Mike	Southeast Toyota Distributors	Director, Technical Operations at Southeast Toyota	Jim Moran Blvd	Florida	33442
Foote	Jennifer	Beep	VP Customer Success at Beep	13485 Veterans Way 110	Florida	32827
Forest	Wanda	North Florida Transportation Planning Office	Transportation Planning Manager	980 N Jefferson St	Florida	32209
Larson	Marci	North Florida Transportation Planning Office	Public Affairs Manager	980 N Jefferson St	Florida	32209
Feldman	Michael	JTA	Assistant Vice President	100 LaVilla Center Drive	Florida	32204

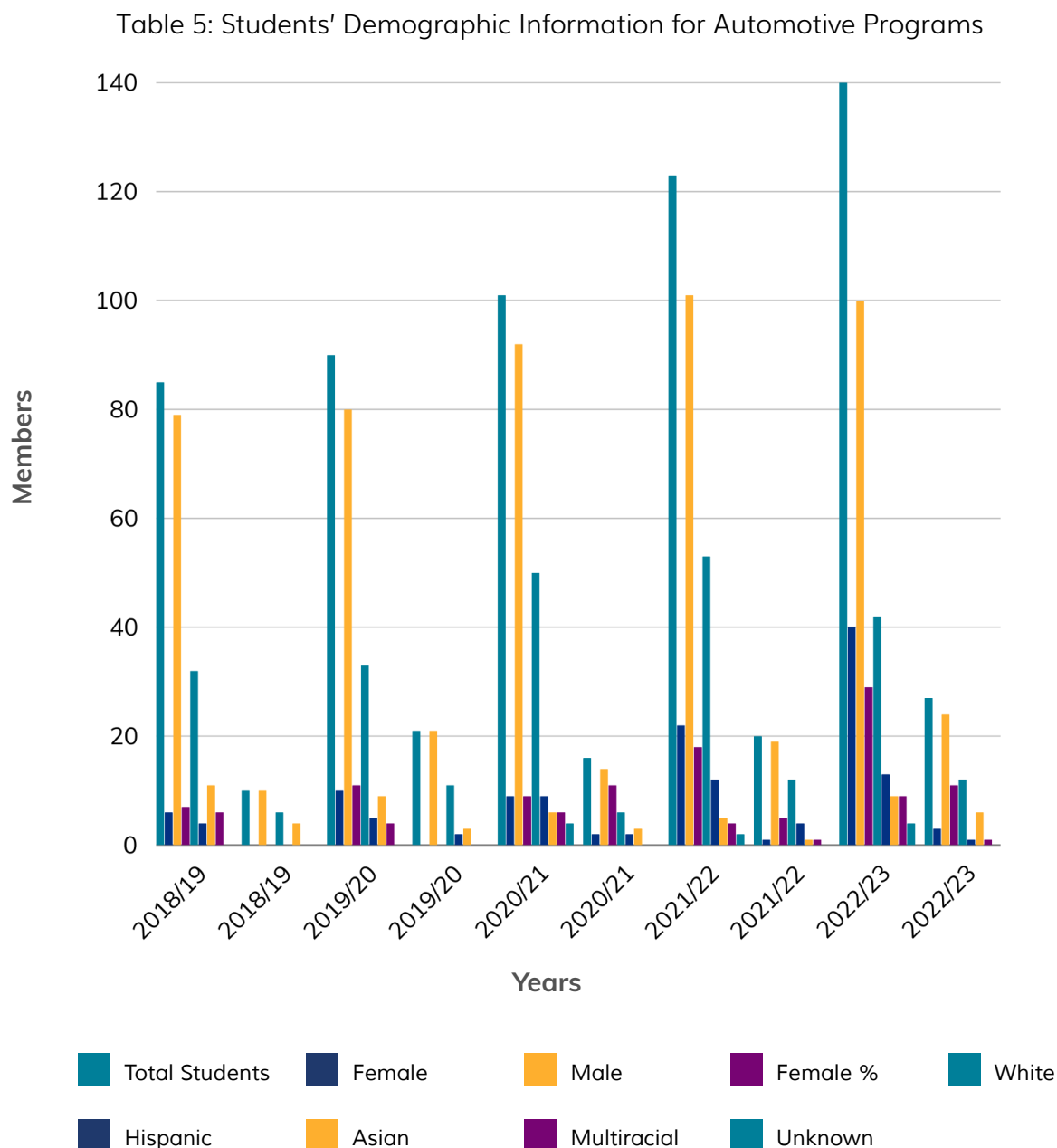
Figure 1: ADAS BILT Advisory Team Meetings



Objective 1.3 stated that the project team would work with ASE, NC3, SAE International, and the Connected Vehicle Trade Association to develop an ADAS industry certification. Professor Soar, the Principal Investigator, collaborated with the certification development committee of the Automotive Service Excellence (ASE) organization, leading to the launch of a new national ADAS technician certification. This certification was offered for the first time in the summer of 2022 through ASE. Professor Soar was privileged to contribute to the development of this new national certification with ASE.

Following is the analysis of **Objective 1.4**, related to recruiting and enrolling 40 students in the ADAS courses by the end of the project period, and **Objective 1.6**, related to increasing the enrollment of underrepresented populations by 5 percent per year during Years 2 and 3, specifically focusing on women and students from underrepresented populations to create a diverse technician workforce. Table 5 provides detailed data on student enrollment and demographic changes over the project period. Key metrics included in Table 5 are the total number of students enrolled in ADAS courses, the percentage of female students, and the percentage of students from underrepresented populations.

Table 5 shows a steady increase in student enrollment, meeting the goal of enrolling 40 students in ADAS courses by the end of the project period. There has been a notable increase in the enrollment of female students, aligning to focus on underrepresented populations. Demographic data indicate a significant rise in the number of female students, achieving the goal of a 5 percent increase per year during Years 2 and 3 (Table 6). Figure 2 is a visual representation of the ADAS course enrollment and demographic data based on Table 6, which illustrates the total enrollment over the four years of the project, along with the percentage of female students and students from underrepresented populations.



Note. A.A.S = Automotive Service Management Technology; T.C. = Automotive Service Technician

Table 6: Female and Underrepresented Students' Demographic Information for Automotive Programs

Year	Program	Total Students	Female %	Underrepresented Population (%)
2018/19	A.A.S and T.C	95	6	54
2019/20	A.A.S and T.C	111	9	53
2020/21	A.A.S and T.C	117	9	41
2021/22	A.A.S and T.C	143	16	37
2022/23	A.A.S and T.C	167	26	38

Note. Underrepresented population = Black + Hispanic + Asian + Multiracial

Figure 2. ADAS Course Enrollment for Female and Underrepresented Population

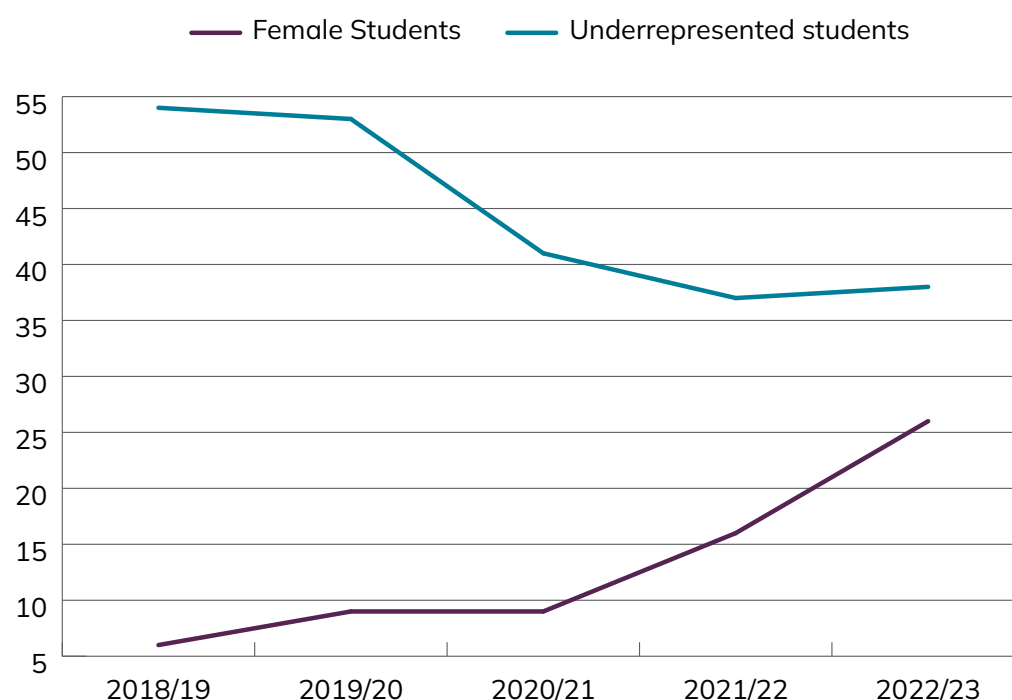
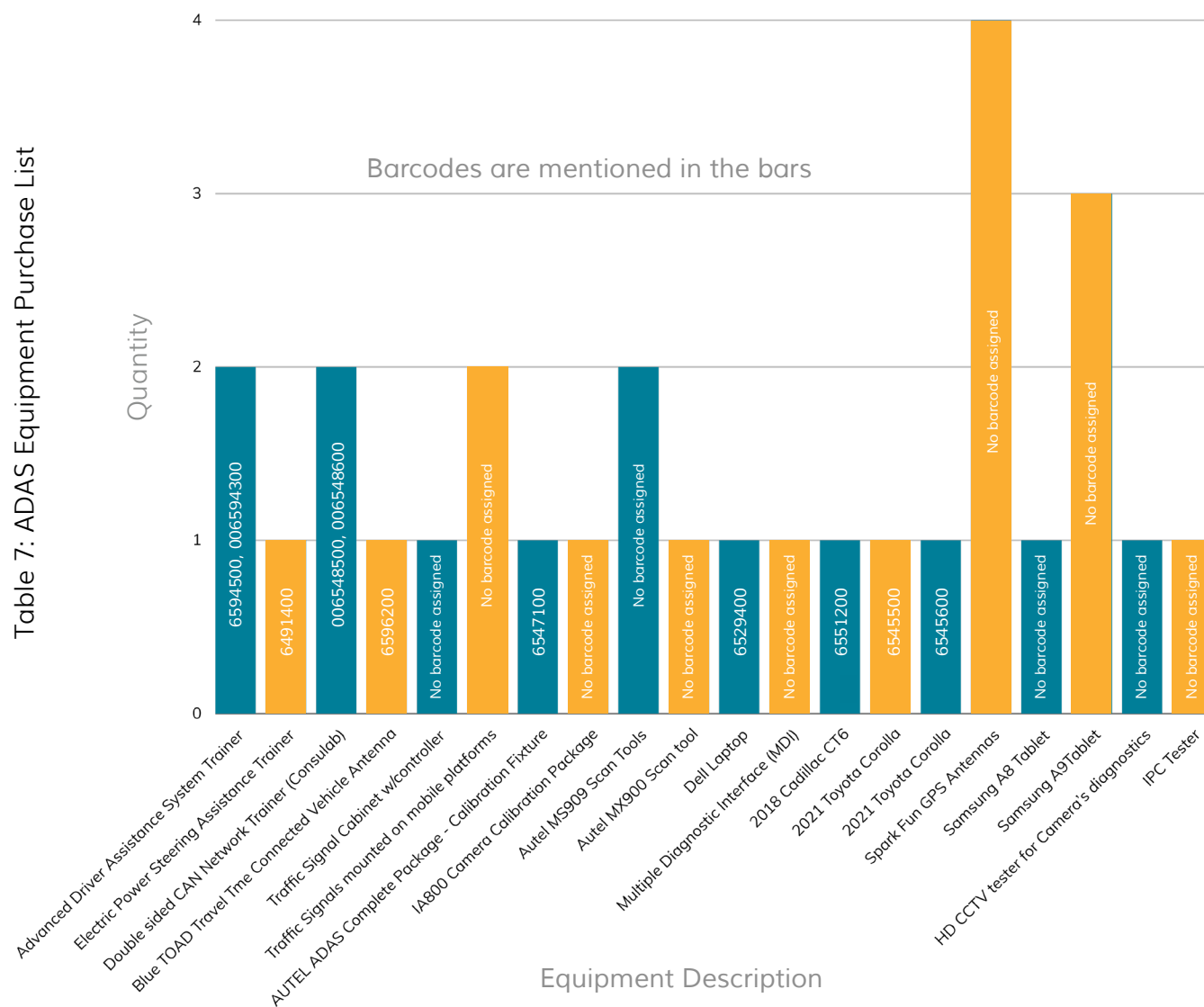


Figure 2 illustrates the steady increase of all students from Year 1 to Year 4. It also shows the sharp increase of female students from the program's first to the fourth year. Results from the analysis of student demographic data from years 1 through 4 show that engagement of underrepresented students in the ADAS program and courses over the project's lifetime has a relatively steady enrollment rate from 37% to 54%. However, the overall trend of enrolling underrepresented population is a bit going downward.

Goal 2 was related to establishing Autonomous Vehicle simulation and ADAS lab training equipment for students to practice applied skills. Within goal 2, Objective 2.1 was to acquire simulation equipment in Year 1 inclusive of 2019 Toyota with Safety Sense 2.0, 2018/19 Cadillac CT6 GM Super-Cruise, ADAS camera calibration tool with multiple placards, suitable scan tool (Generic, Toyota Techstream, GM MDI w/GDS2 access) following purchasing and procurement procedures. Table 7 provides a comprehensive list of the simulation equipment acquired for the ADAS Tech program, addressing Objective 2.1. The table details the quantity, description, and barcodes of various pieces of equipment purchased to enhance the practical training components of the program. Table 7 includes essential items such as the Advanced Driver Assistance System Trainer, Electric Power Steering Assistance Trainer, multiple CAN Network Trainers, etc. By acquiring this equipment, the program ensured that it had the necessary tools to provide hands-on, up-to-date training for students, meeting the objective of acquiring simulation equipment in the first year. Equipment acquisition supports the development of the student's skills in advanced driver assistance systems, aligning with industry standards and preparing them for the evolving automotive workforce.

Table 7: ADAS Equipment Purchase List



Objective 2.2 focused on providing face-to-face faculty and simulation lab coordinator training workshops in Years 1 and 2 with in-service, ongoing training, and professional development offered throughout the project. Objective 2.3 focused on training 10 faculty members in equipment throughout the project. Table 8 shows multiple training providers, course topics, training hours and completion dates, and faculty members participating in the training sessions. There was a total of 8 faculty members and one administrator participating in the equipment training sessions, including Paul Soar, Steve McCauley, Jason Hamilton, Robert Wechsler, Mike McGill, Dana Burnes, Jake Pulver, and David DiCarlo. The training sessions in Table 8 highlight the project's commitment to equipping faculty and lab coordinators with the necessary skills and knowledge to deliver ADAS education effectively.

Table 8: Intellectual Competencies of Courses

Provider	Title of Course	Hours	Participating Faculty	Date Completed	Year
Society of Automotive Engineers	Introduction to Highly Automated Vehicles	16	Paul Soar	December 9	2020
ICAR-I-Car	Calibration of Front Facing Cameras and Front Radars	1	Paul Soar	October	2020
ICAR-I-Car	Camera Calibration, Inspection, and Initialization Requirements	1	Paul Soar	October	2020
ICAR-I-Car	AUTEL® MaxiSys® Diagnostic Tablet and Calibration Kit	1	Paul Soar	October	2020
ICAR-I-Car	Calibration Requirements for Blind Spot and Parking Assist Systems	1	Paul Soar	October	2020
I-Car	Pro Level 1 ADAS training course	9	Jason Hamilton		
ASE/Toyota training	Millimeter radar and front recognition camera	1.5	Paul Soar	November 25	2020
ADAS Professor	ADAS Calibration and Diagnostics	8	Paul Soar	November 5	2020
2020 APPEX Conference	ADAS Calibration and Diagnostics		Paul Soar	November 5	2020
AUTEL Calibration training	Advanced Driver Assistance Calibration Training	8	Paul Soar	May 26	2021
BEEP	Specialized training with a Level 3 automated people mover shuttle from Local Motors	8	Paul Soar Robert Wechsler Steve McCauley	May 30	2021
Local Motors	Dean, Dr. Brauer, and Paul Soar (PI) visited Local Motors to discuss the manufacturing, engineering, and autonomous features of the Olli, a mass transit shuttle with level three autonomy.		Paul Soar Douglas Brauer	May 6	2021
Connected Vehicle Trade Association (CVTA)	Course on the Connected Vehicle Profession	29		May	2022
Self Drive Sinclair	ADAS training from multiple manufacturers focused on automated and connected vehicle technology	29	Paul Soar	July 26-30	2022

Objective 2.4 was to provide learning experiences for 20 professional incumbent workers. Twenty-five professional incumbent workers were trained in the program, surpassing the objective of providing learning experiences for 20 workers. The training sessions included diverse attendees such as shop owners, technicians, fleet service technicians, and managers, ensuring a wide range of professional development across different roles in the automotive industry. The training sessions covered essential topics related to operating various ADAS systems and common ADAS sensor types, ensuring that the workers received in-depth knowledge and practical skills relevant to their field.

In 2022, a pre-and post-survey was delivered to 10 incumbent workers to assess their understanding of lane assistance sensors and the use of the LIDAR to assist drivers. Table 9 shows the demographics of incumbent workers enrolled in the Advanced Driver Assistance Systems Training and Calibrations workshop (Blackmon, 2022). Ten industry workers participated in the workshop. All participants were male. There was diversity in the participants' titles. Titles ranged from Intern to Owner. Most participants in the incumbent workshop worked at AirPro Diagnostic, the Jacksonville Transportation Authority (JTA), and FSCJ.

Table 9: Incumbent Workers Demographics Table

Characteristic	N = 10 ¹	Characteristic	N = 10 ¹
Work Title		Workplace	
Auto diagnostic analysis	1 (10%)	Air Pro Diagnostic	1 (10%)
Automation Engineer	1 (10%)	AirPro Diagnostic	1 (10%)
Automation Intern	1 (10%)	AirPro Diagnostics	1 (10%)
Automotive Diagnostic Apprentice	1 (10%)	Auto spec	1 (10%)
CRR Instructor	1 (10%)	B R Auto Service	1 (10%)
Diesel Technology Instructor	1 (10%)	Characteristic	N = 10¹
Embedded Technician	1 (10%)	Florida State College® Jacksonville	1 (10%)
Mechanic	1 (10%)	FSCJ	1 (10%)
Owners	1 (10%)	Jacksonville Transportation Authority	1 (10%)
Technical Support Coordinator	1 (10%)	Jacksonville Transportation Authority	2 (20%)
		Gender	
		Male	10 (100%)
		¹ n (%)	

Figure 3 shows the pre-and post-test scores for each question. The question asking participants about the SAE classification of the device to help drivers maintain their lane and the question asking how about the apparatus that rotates 360 degrees on the rooftop and can perceive the surrounding environment at high accuracy with high resolution showed the largest increase from the pre- to post-test correct responses. This significant increase shows that participants learned more about lane assistance sensors and using the LIDAR to assist drivers.

Figure 3: Pre-Post Scores for Incumbent Workers

I'm found rotating 360 degrees on rooftops of vehicles, perceiving the environment with high accuracy and resolution. What am I?

I'm widely used in Parking Assist systems. Can you identify me?

At what speed (m/sec) do ultrasound waves travel in air?

I can tell you how fast to drive. Which ADAS system am I?

Which sensor is used for Traffic Sign Recognition?

Which sensor's performance isn't affected by bad weather?

Which Radar sensor type is used for ACC applications?

What signals are most common in Automotive Radar?

Which sensor directly measures object velocity?

I help maintain your lane by steering, but not longitudinal control. What SAE level am I?

I alert the driver if the vehicle drifts from its lane. Who am I?

Which ADAS function maintains a constant speed and safe distance from the vehicle ahead?

How do ADAS systems assist drivers?

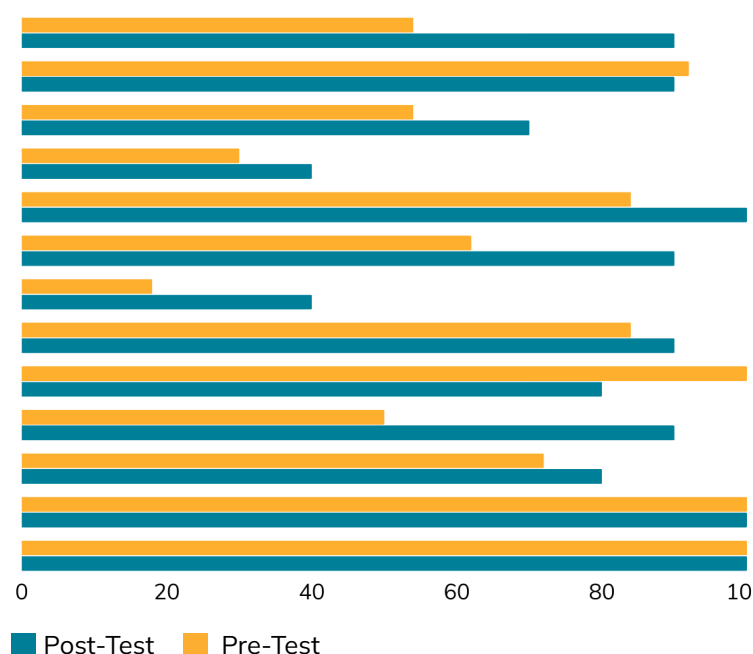


Table 10. Paired Samples T-test Results of Test Scores Table

Dependent Variable	t	df	p	d	95% CI
Test Scores	-2.18	9	.057	-0.69	[-1.44, 0.02]

Table 10 shows the analysis between pre-and post-test responses. A paired-sample t-test was conducted to examine if there was a significant change in test scores from before to after the workshop. No significant change was found ($t(9) = -2.18, p = .057$). Test scores are shown to increase over time. However, the difference was not statistically significant.

Goal 3 was to ***promote career pathway awareness and strengthen mathematics and science skills for 40 high school students from underrepresented groups in the automotive industry. Objective 3.1 focused on the project hosting multiple career exploration events with hundreds of high school students to explore ADAS technology and career ladders for employment with ADAS technology.*** These events focused on increasing high school students' mathematics and science skills for underrepresented groups. Table 11 provides an overview of various career pathway awareness activities hosted as part of the ADAS project, focusing on increasing mathematics and science skills among high school students. Table 11 lists the events, dates, participants, activities, and outcomes. It also lists events, including summer boot camps, career exploration lectures, and other educational sessions tailored to different student groups, ensuring broad participation. Events such as the Youth Leaders Development Program Event and North Campus Take-Over Day involved significant numbers of high school students, thereby meeting the objective of engaging hundreds of participants.

Each event strongly focused on ADAS technology, with activities ranging from hands-on workshops to discussions and live demonstrations, ensuring students gained practical insights and knowledge. The activities were designed to enhance STEM skills, with specific emphasis on technology related to ADAS, such as obstacle detection, coding, and understanding vehicle sensors. These skills are critical for careers in ADAS technology and align to increase students' awareness of ADAS technologies and improve their mathematics and science competencies. The project successfully met Objective 3.1 by conducting these events, promoting career pathway awareness, and strengthening essential STEM skills among high school students, especially from underrepresented groups.

Notably, in 2021 summer, the ADAS project team hosted a summer camp to prepare college and high school students with skills necessary for workforce entry, focusing on Advanced Driver Assistance Systems (ADAS). The program included instructions on technologies such as LiDAR, radar units, ultrasonic transmitters, and steering angle sensors. ILC employed impact-based methods to assess changes in students' STEM self-efficacy. Pre- and post-surveys were used to measure students' confidence levels before and after the four-day camp.

There were 14 participants from 8th-grade to 12th-grade level. Self-efficacy was measured on a scale from 1 (strongly disagree) to 5 (strongly agree), and scores were averaged to create a mean self-efficacy score. The self-efficacy score has increased significantly ($t(13) = -3.84, p = .002, d = 1.03$) from pre-survey (Mean = 4.04, SE = 0.15) to post-survey (Mean = 4.36, SE = 0.11), which means the summer camp has improved students' self-efficacy on STEM abilities. Figure 4 shows the average self-efficacy score by items.

Figure 4: Average Self-Efficacy Scores by Question

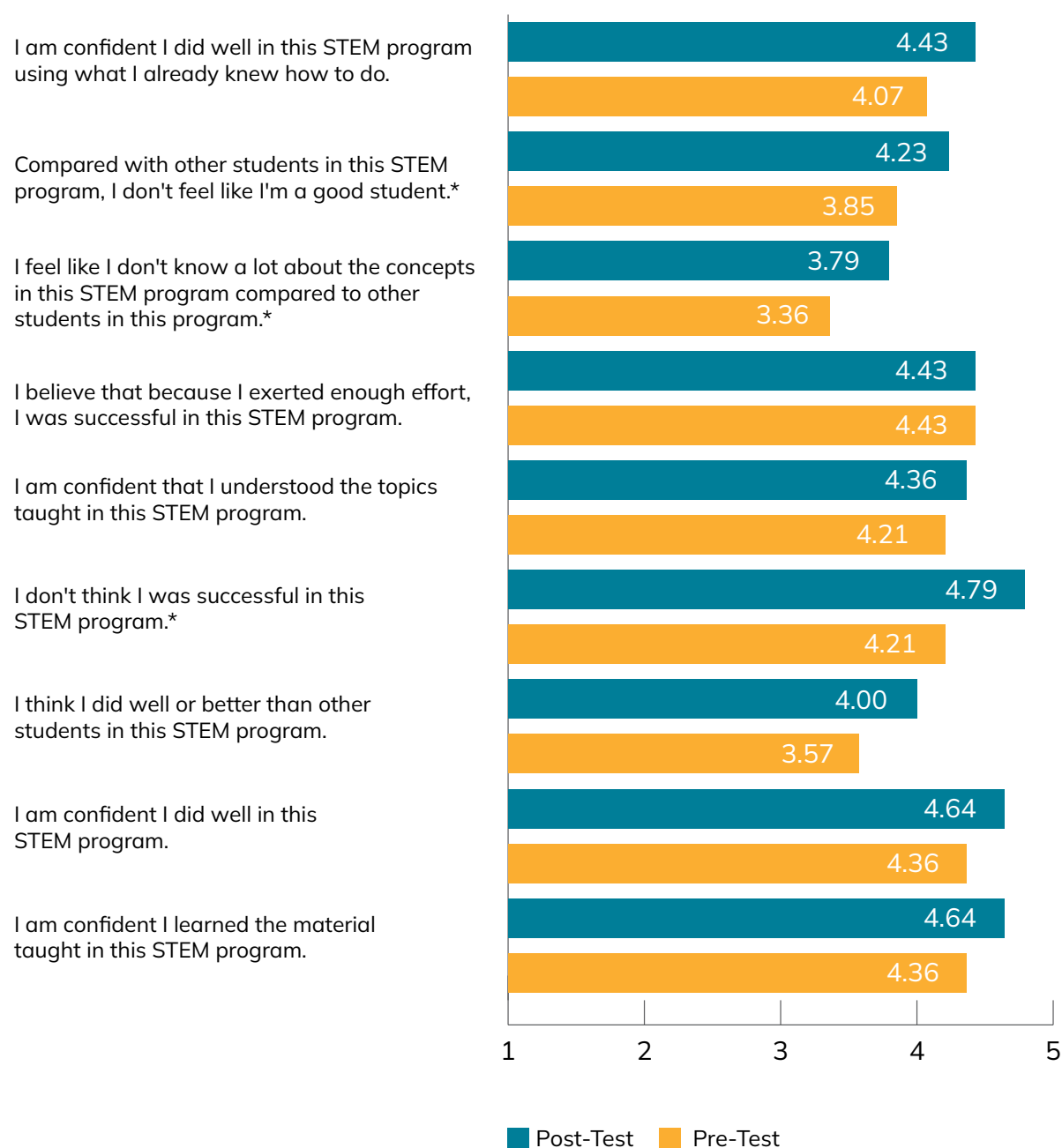


Table 11: Promoting Career Pathway Awareness Activities

Event	Date	No. of Participants	Participant Type	Activities and Outcomes
Summer Boot Camp	Jun.20-22, 2023		Middle and High School Students	Introduction to obstacle detection, hands-on robotic car building, coding, live vehicle demonstrations, obstacle avoidance, and emergency braking demonstrations.
Career Exploration Lecture	Oct.18, 2023	50 students	Frank H. Peterson Career Academy	Career exploration in ADAS technology.
Summer Boot Camp	Jun.20-22, 2023		Middle and High School Students	Repeated events from the previous year.
Educators Discussion	Mar. 7, 2024	16 educators	Teachers from South Africa	Discussion on education and career pathways in autonomous and connected cars.
Youth Leaders Development Program Event	Apr.2, 2024	60 high school students	Englewood, Atlantic Coast, and Riverside High Schools	Introduction to ADAS and its sensors.
North Campus Take-Over Day	May 2, 2024	35 students	Five high schools	Career awareness in ADAS and technology related to science education and careers.
Presentation to IT STEM Club	May 2, 2024		FSCJ Students	Presentation on Autonomous Vehicle sensors and operation.
Science of ADAS Event	Apr.23, 2024	25 elementary school students	Long Branch Elementary	Introduction to the science of ADAS and Autonomous vehicle sensors and mapping.

Table 12: STEM Teachers Event Focusing on ADAS Technology Agenda

Time	Activities
8:30 AM- 9:00 AM	Welcome & Introductions
9:00 AM – 10:15 AM	ADAS Systems Overview
10:15 AM – 10:30 AM	Break
10:30 AM – 12:00 PM	ADAS Systems Sensors
12:00 PM – 12:30 PM	Lunch
12:30 PM – 1:30 PM	ADAS Centerline
1:30 PM – 2:15 PM	ADAS Calibration - Front Wave Radar
2:15 PM – 2:30 PM	Break

Objective 3.2 was to adapt the ADAS technology education curriculum for face-to-face faculty workshops implemented in Years 2 and 3 to align with the content needs of high school teachers.

On June 5, 2024, the FSCJ ADAS project team provided a one-day workshop for high school teachers (Table 12). The goal was to align the ADAS education curriculum with the needs of high school teachers, ensuring that they can effectively teach these concepts to their students. The training was designed to ensure teachers understand the theoretical and practical aspects of ADAS technologies. The workshops provided resources and lesson plans that teachers can integrate into their high school curricula. The training covered various aspects of ADAS technology, including its importance, the different levels of automation, and specific systems such as Adaptive Cruise Control, Lane Keeping Assistance, Blind Spot Monitoring, and Automatic Emergency Braking. Teachers were introduced to the four main types of ADAS sensors: Ultrasonic, Cameras, Radar, and LiDAR. Each sensor's capabilities, limitations, and applications were discussed in detail. Hands-on calibration exercises were conducted, such as determining the geometric center line and calibrating front radar and forward-facing cameras. The training also included discussions on sensor fusion, combining multiple sensor data to form a comprehensive view of the vehicle's surroundings. A pre-and post-survey was administered to evaluate teachers' learning and perceptions of this workshop.

Hands-on calibration exercises were conducted, such as determining the geometric center line and calibrating front radar and forward-facing cameras.

Table 13 lists the descriptive data for pre- and post-survey results, including participating teachers' gender distribution, school location, teaching grade level, and test scores. The analysis results indicate that the pre-survey (N=10) and post-survey (N=6) groups had an equal gender distribution, with 50% female and 50% male participants. Participating teachers taught grades from 8th to high schools across various locations in the United States. The average test score increased from the pre-survey (Mean = 43.90, SD = 17.82) to the post-survey (Mean = 50.00, SD = 10.95). Increases in test scores indicate that teachers' knowledge of ADAS sensors and sensor fusion has increased. An independent samples t-test was conducted to examine the difference in test scores between pre- and post-survey responses. No significant differences were found in the test scores ($t(14) = -0.75$, $p = 0.465$) from pre- and post-survey responses. Figure 5 presents the mean error plot of test scores between pre- and post-survey.

Table 13: Descriptive Table for Pre- and Post-Survey Results for Teachers' Event

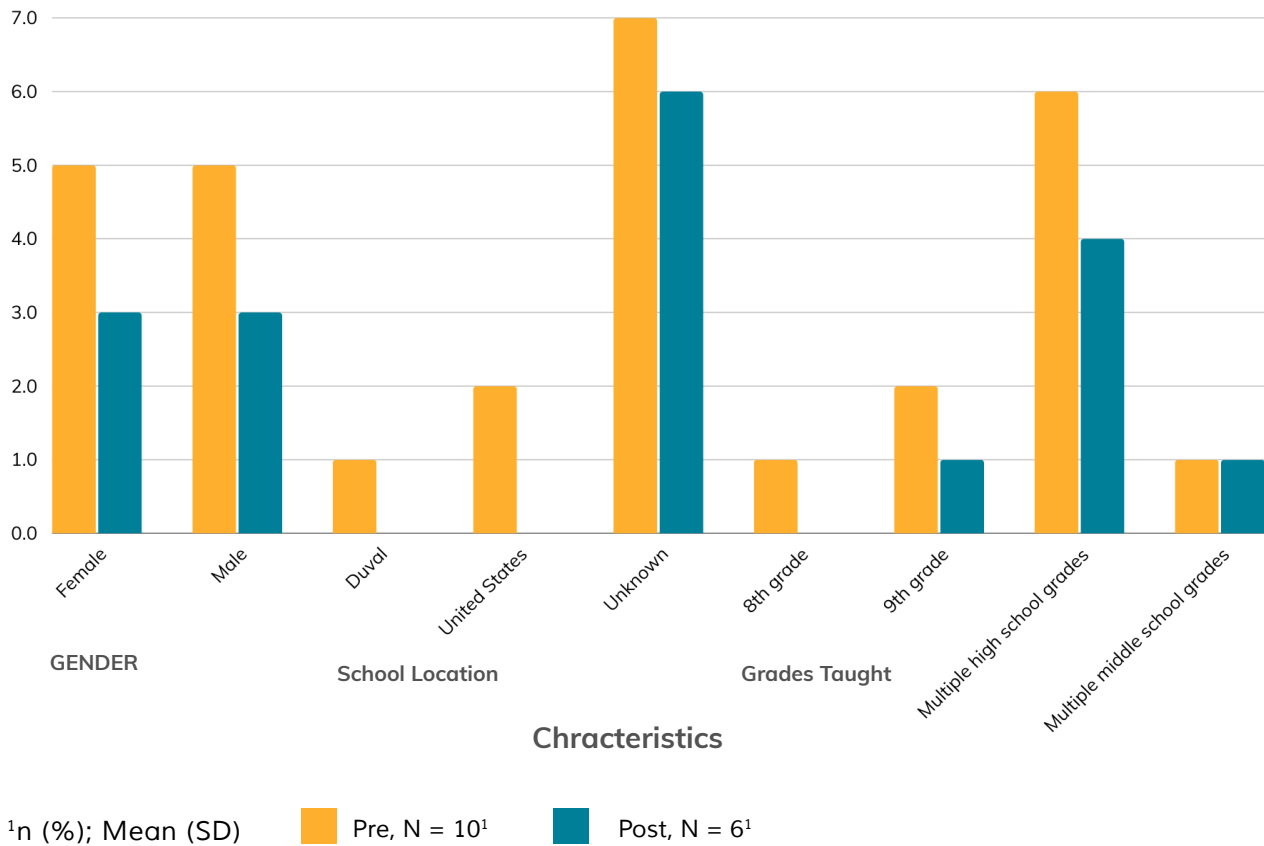


Figure 5: Mean Error Plot of Test Scores Pre- and Post-Survey Scores

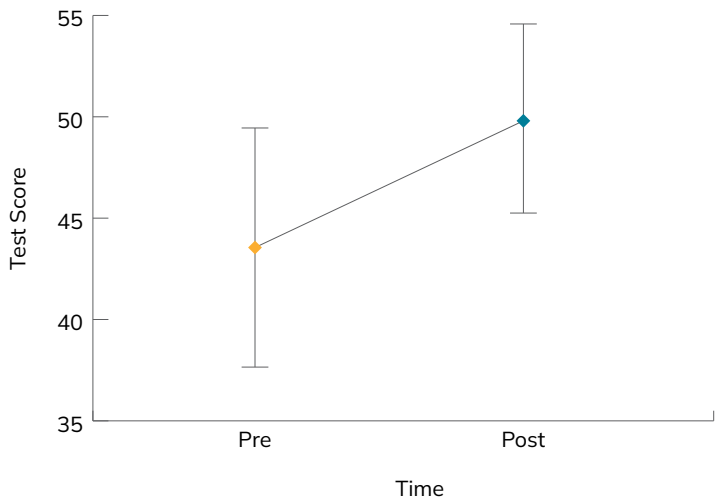


Figure 5 presents the mean error plot of test scores between pre- and post-survey. It also shows an increase in test scores from the pre- to the post-test.

Objective 3.3 was to develop a career ladder to articulate high school dual-enrollment credit into automotive technology associate degree programs at FSCJ, increasing the career ladder partnership with one local high school. The ADAS project team is developing a career ladder to articulate high school credit into automotive technology associate degree programs at FSCJ, increasing partnership with multiple local high schools. The pathway hopes to include local county schools in Duval, Baker, Clay, and Nassau counties. The plan consists of offering credit towards automotive classes after completing courses within the high school automotive program. One pathway has been developed with the Foundation Academy, a private school. The first enrollment course will be offered in the Fall of 2024.

Table 14 outlines the key engagements of PI Paul Soar in disseminating project outcomes. Professor Soar attended various conferences and meetings on Advanced Driver Assistance Systems (ADAS) and autonomous technologies. In October 2023, Paul Soar attended the ATE Conference, where he presented a session on "Shifting Education towards Electric and Autonomous Technologies," discussing advancements in ADAS and the transportation industry's shift towards autonomous technologies. He also participated in the Connects session at the ATE PI Conference during the same month. In April 2024, Professor Soar presented at the FSCJ Spring Division Meeting, participating in a panel discussion on AI and Autonomous Vehicles, where he demonstrated a training path for ADAS and Connected Vehicles as part of AI education. These engagements highlight the dissemination of best practices and advancements in ADAS education and technology.

Table 14: ADAS Project Dissemination Activities

Date	Conference	Data Dissemination Activities	Attendees
October 2023	ATE Conference	Presented in the session 'Shifting Education towards Electric and Autonomous Technologies.' This session discussed the advancements of ADAS and the shift into autonomous technologies and outlined the creation of new courses, materials, and best practices under the ADAS Tech grant.	Paul Soar (PI)
October 2023	ATE Conference	Participated in the Connects session at the ATE PI conference.	Paul Soar (PI)
April 1, 2024	FSCJ Spring Division Meeting	Presented on a panel discussion for the FSCJ Spring Division meeting on AI and Autonomous vehicles. Demonstrated a training path for ADAS and the Connected Vehicle as part of AI education.	Paul Soar (PI)

Discussions

Autonomous cars and intelligent vehicles are becoming part of our daily lives, moving beyond science fiction. Advances in autonomous vehicles promise significant improvements in quality of life. Increased technology in the automotive industry may allow us to replace driving time with community volunteering or work during commutes, freeing up time for outdoor activities. Enhanced safety features may reduce automotive-related injuries and fatalities. By 2030, 12% of new cars will have autonomous technologies, rising to 40% by 2035. These advancements will make vehicle repair and maintenance more complex, requiring specialized ADAS technicians trained in science, engineering, and mathematics. Florida State College at Jacksonville (FSCJ) implemented the ADAS Tech program to prepare individuals for this emerging workforce, addressing the growing need for expertise in ADAS technologies. The following section discusses the strides the project team made toward accomplishing the goals and objectives identified in the funded proposal.

Goal 1: Develop, Modify, and Create Course Curricula Modules

The ADAS Tech program has made significant strides in enhancing its curriculum to better prepare students for the evolving automotive industry. Modifying five courses and developing two new courses has ensured that the program remains current with industry standards and technologies. Collaborating with industry partners and forming the Business & Industry Leadership (BILT) Team has been instrumental in aligning the curriculum with real-world needs. The active involvement of industry experts in course development has ensured that students acquire relevant skills, making them workforce ready. Additionally, the program has successfully increased enrollment, particularly among underrepresented populations, by focusing on inclusive recruitment strategies.

Goal 2: Establish Autonomous Vehicle Simulation and Lab Training

The acquisition of advanced simulation equipment, including vehicles and diagnostic tools, has enhanced the practical training component of the ADAS program. Faculty and simulation lab coordinators have undergone comprehensive training, ensuring they are well-equipped to deliver hands-on education to students. The program has also exceeded its objective by providing professional development opportunities to 25 incumbent workers, surpassing the goal of 20. Pre- and post-survey analysis from the 5-day training session showed that participants learned more about lane assistance sensors and using the LIDAR to assist drivers. This training has covered various ADAS systems and sensor technologies, ensuring faculty and incumbent workers are proficient in the latest automotive advancements.

Goal 3: Promote Career Pathway Awareness

The ADAS Tech program has effectively promoted career pathway awareness through various events targeting high school students, particularly from underrepresented groups. Events such as summer boot camps, career exploration lectures, and educational workshops have provided students with hands-on experience and insights into ADAS technology. These activities have increased students' interest in automotive careers and strengthened their mathematics and science skills and STEM self-efficacy, which are crucial for success. Moreover, the first cohort of high students' confidence in their ability to learn ADAS was strengthened. The ADAS summer teachers' training session showed a trend toward improved test scores, but changes were not statistically significant. Improved test scores suggest that while the program has improved teacher training test scores, modifications are still needed to achieve a more substantial impact. The program has also developed a career ladder to facilitate the transition of high school students into automotive technology associate degree programs, further supporting long-term career development.

Recommendations

First, the ADAS project team can consider sustaining student enrollment and diversity by securing additional funding to offer scholarships and financial assistance to students from diverse backgrounds. Second, the ADAS project team can consider developing partnerships that offer students more internships and cooperative education opportunities to gain real-world experience. Furthermore, only one local high school participates in the dual enrollment program. The ADAS project team can extend their efforts to engage additional high schools and expand the dual enrollment program. Lastly, the enrollment rate of underrepresented populations (Black, Hispanic, Pacific Islander, Asian, and Multiracial students) is going downward. More strategies may be needed in order to improve the enrollment of underrepresented populations.





Summary

Overall, the ADAS Tech program has achieved its primary goals through curriculum enhancement, practical training, and career pathway promotion. The program's success is evident in the increased student enrollment, enhanced faculty capabilities, and the positive impact on high school students' STEM skills and career awareness. The ADAS Tech program continues to significantly contribute to the automotive workforce by maintaining strong industry partnerships and focusing on inclusive education.

References

Bagloee, S. A., Tavana, M., Asadi, M., & Oliver, T. (2016). Autonomous vehicles: challenges, opportunities, and future implications for transportation policies. *Journal of Modern Transportation*, 24, 284-303.

Blackmon, A.T. (2022, June). *Advanced Driver Assistance Systems Technicians: Year Two Formative External Evaluation Report*; Atlanta, GA, Innovative Learning Center, LLC. Grant No. 2000618. <http://doi.org/10.520.12/ILNJ2233>.

Deichmann, J. (2023). *Autonomous Driving's Future: Convenient and Connected*. McKinsey.

Kaur, P., & Sobti, R. (2017, September). Current challenges in modelling advanced driver assistance systems: Future trends and advancements. In *2017 2nd IEEE International Conference on Intelligent Transportation Engineering (ICITE)* (pp. 236-240). IEEE.



www.ilearningcenter.com
ilc@ilearningcenter.education
404.880.3309



@ilearningcenter.education

Innovation Learning Center, LLC
1100 Peachtree Street NE, Suite 250
Atlanta, Georgia 30309

We thank you for your continued support in our efforts to provide external evaluation data analysis services for programs that advance high-quality STEM education for students and faculty.