Exploring Transportation Career Awareness through University-Hosted Summer Camps

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Abstract

The U.S. Department of Transportation (USDOT) has announced a strong need for diversified workforces in the transportation industry now and beyond the 21st century. Career awareness of choices and opportunities existing in the transportation industry for secondary school students is very important to help increase the number of students pursuing advanced degrees and careers in transportation-related fields, deliver STEM-capable workforces, and broaden the participation of women and minorities in transportation fields. Career seminars, university-hosted summer camps, and competitions are some of the common career awareness methods for secondary school students.

The objective of this study is to explore the effectiveness of university-hosted transportation-focused summer camps for transportation career awareness and diverse workforces. Based on data collected from the National Summer Transportation Institute (2022) and Summer Transportation Institute (2023) summer camps that were organized and hosted at the University of North Texas, it is observed that transportation-focused summer camp activities work very well for student transportation career awareness, which significantly improved students' familiarity with transportation knowledge and their interest in transportation careers. However, summer camp activities work significantly better for male students than female students and for Asian and White students than other students. Therefore, activities specifically designed to promote the involvement of female students, African-American students, Latino or Hispanic students, and Native-American students need to be considered for summer camp activities.

Introduction

The U.S. has shown a strong need for a diverse workforce in the transportation industry now and beyond the 21st century. For example, for the highway industry, in January 2023, the roads and streets in the USA witnessed a significant surge in travel, with a 5.6% increase, totaling 13.2 billion additional vehicle miles compared to the same month in the previous year. This substantial growth is discernible in the seasonally adjusted vehicle miles traveled, which reached 272.5 billion miles, representing a 4.5% change over January 2022 and a notable 3.1% change compared to December 2022 [1]. According to the Federal Highway Administration (FHWA), Americans' average daily vehicle miles of travel is 5.35 billion miles as of 2021 [2], while in Texas, the average daily vehicle miles traveled contributed to 772.7 million miles, with a grand annual total of 282.2 billion miles [3]. With the significant surge in travel and the continuously increasing vehicle miles traveled in the USA, there is a growing need for a substantial and skilled workforce to ensure the maintenance and upkeep of the roads and infrastructure. The conditions in other transportation industries, such as aviation, are similar to the FHWA. According to the U.S. Department of Transportation statistics, employment in the transportation and warehousing sector increased to 6.7 million workers in 2022, up by 8.2 percent from 2021 [4]. Employment among civil engineers will increase by 11% between 2016 to 2026.

However, university enrollment trends suggest that growth in degrees in civil engineering will fall short of the projected 11% [5]. To address this issue and to ensure a prosperous future for the transportation industry and its various components, it is imperative to increase the number of students pursuing STEM degrees and careers in transportation while simultaneously diversifying the pool of students entering these fields [6], [7]. Career seminars and university-hosted summer camps and competitions are some common career awareness methods for secondary school students. The objective of this study is to explore the effectiveness of university-hosted transportation-focused summer camps for transportation career awareness and diverse workforces based on collecting and analyzing data from the National Summer Transportation Institute (2022) and Summer Transportation Institute (2023) camps that are hosted at the University of North Texas.

Transportation Career Awareness

To explore the effectiveness of university-hosted transportation-focused summer camps for transportation career awareness and diverse workforces, the organized camp provides a 2.5-week summer program for middle/high school students (8-10th grades) in Dallas-Fort Worth (DFW) area to provide them the awareness of careers in the transportation industry, to encourage them to take transportation-related curricula, and to pursue advanced degrees and careers in Transportation in the future. This research is part of the Summer Transportation Institute program supported by the Texas Department of Transportation and the U.S. Federal Highway Administration. The objective of this research is to collect data and conduct analysis for the following research questions related to transportation career awareness and diverse workforces through summer education programs. Below are the research questions we would like to answer from this research:

1. Can summer camp activities, in a short time, effectively improve the familiarity with transportation knowledge among secondary school students?
2. Can summer camp activities, in a short time, effectively improve the interest in transportation careers among secondary school students?
3. For the diverse workforce, do gender and ethnicity impact career awareness results?

UNT Summer Transportation Institute (STI)

To answer the formulated research questions, in this study, there were designed activities that are included in the 2022 National Summer Transportation Institute (NSTI) and 2023 TxDOT Summer Transportation Institute (STI) programs; these activities include four categories: academic lectures, hands-on labs, field trips, and other activities. Other activities include orientation and campus tours, enhancement programs (meetings with student associations and the administrators of the College of Engineering), sports and recreation, etc. Those activities cover several transportation-related career types of TxDOT divisions, including aviation, bridge and highway/road systems, railroad transportation, maritime, transit, artificial intelligence, etc. Figure 1 summarizes the distributions of activities grouped by activity categories (in working hours) and by TxDOT transportation career types (in percentage), respectively. As shown, aviation-related activities take a large percentage. This is because of the well-developed aviation industry in the DFW area, which provides good sources of education.

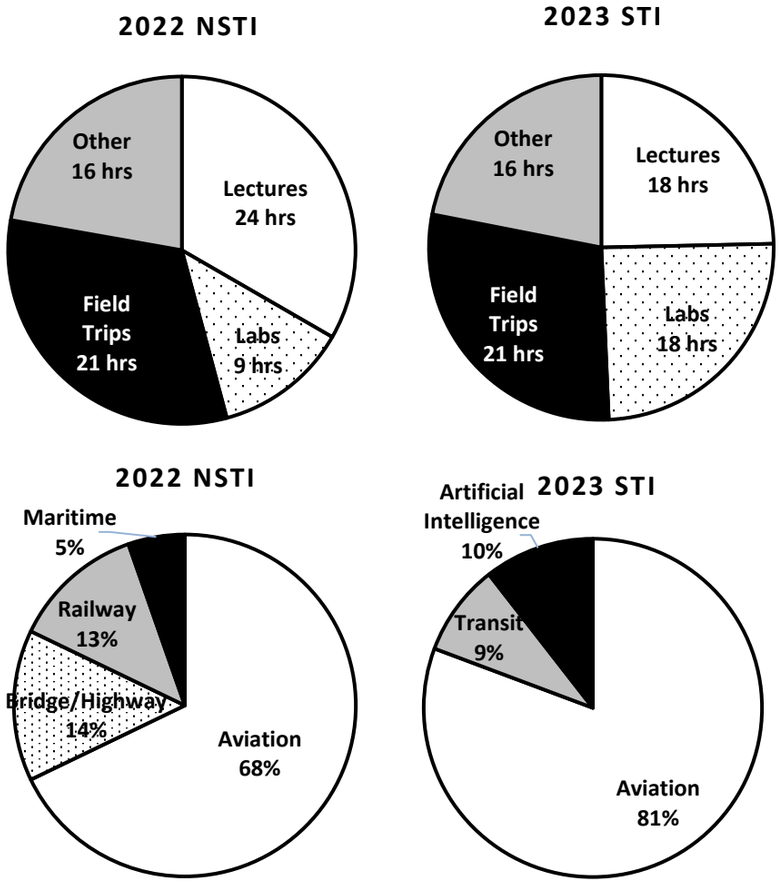

Fig. 1. Distribution of student activities by activity categories (in working hours) and by TxDOT transportation career types (in percentage).

The UNT research team advertised the 2022 NSTI and 2023 STI summer programs to local public and private high schools by reaching out via email directly to the independent school districts (ISD) and school principals and distributing program flyers within the DFW area, including Denton ISD, Frisco ISD, Grapevine-Colleyville ISD, Plano ISD, Sanger ISD, Choctaw Nations, etc. Email applications were used for the 2022 NSTI and QR codes with online application forms were used for the 2023 STI.

Fifty-four and fifty-one prospective applications were received for the 2022 NSTI and 2023 STI summer programs, respectively. Twenty students were selected each year (2022 and 2023) by the research group using an application selection criterion, which includes middle/high school students in the 8-10th grades and a written statement regarding his/her reasons for wanting to attend the 2022 NSTI or 2023 STI program, and how the program would benefit his/her academic career goals. Racial status was not considered in the application forms, as per TxDOT guidelines.

The UNT NSTI 2022 summer program was implemented from July 11th to July 27th, 2022, as scheduled. The UNT STI 2023 summer program was implemented from June 5th to June 21st, 2023, as scheduled. Figure 2 shows some participating students during selected field trips and lab activities. Student daily attendance remains at 95-100% for the 2022 NSTI and 75-90% for the 2023 STI program.

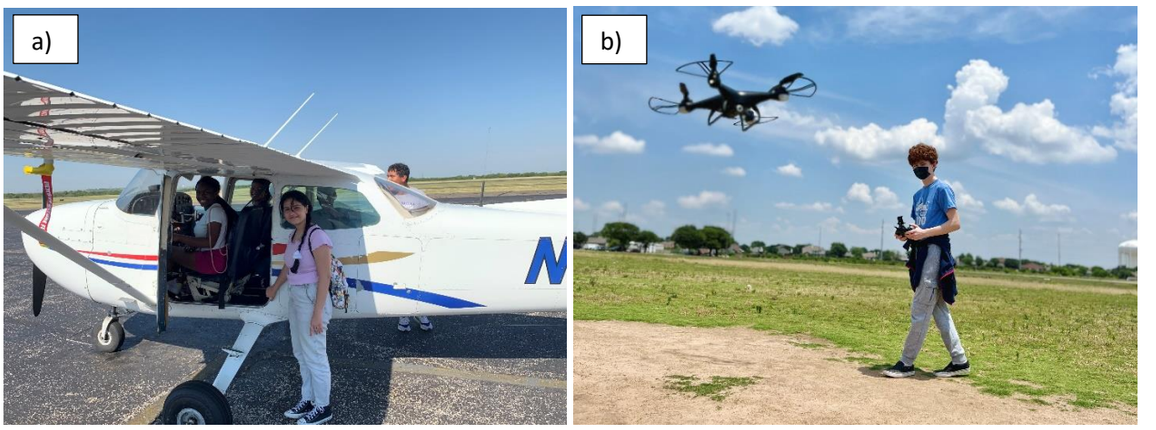

Fig. 2: Example field trip and lab activities: a) US Aviation Academy field trip 2022; b) drone training lab 2023.

Survey, Data Analysis, and Discussions

Student Survey

At the beginning and the end of the 2022 NSTI and 2023 STI summer programs, the middle/high school student participants were asked to complete paper-based surveys. The surveys assessed students' familiarity with transportation knowledge (Q1 = Question 1), and interest in transportation careers (Q2 = Question 2). Numerical values are assigned to each answer choice of the question as "Very familiar = 5", "Familiar = 4", "Somewhat familiar = 3", "Know a little = 2", and "Know-nothing = 1."

All 20 students from the 2022 NSTI summer program responded to all three surveys (beginning, middle, and final); 17 of 20 students from the 2023 STI summer program responded to the beginning and middle surveys and 15 of 20 students responded to the final survey.

To answer research question #1 - Can summer camp activities in a short time effectively improve the familiarity with transportation knowledge among secondary school students? and question #3 - Do gender and ethnicity impact career awareness results? This research conducted analyses of the improvement (end value – beginning value) of Q1 transportation familiarity and Q2 transportation career interests for different genders and different ethnicity statuses, respectively.

Transportation Familiarity Improvement

Figure 3 shows the box and whisker plots of these improvements comparing males, females, all (male + female) including Asian, White, and Others, respectively. Table 1 summarizes the analytical statistics and the t-test results to show if an improvement is statistically significant compared to 0.

It can be observed that (1) the average overall improvement is 1.12 and P-value is 1.323E-07 < 0.10, which shows that the summer program activities can significantly improve the students' familiarity with transportation knowledge; (2) the average improvements in male and female students are 1.32 and 0.50, respectively, and the P-values of the improvements in male and female students are 9.549E-09 < 0.10 and 0.1579 > 0.10, respectively, which show that the improvement for male students is statistically significant, but it is not significant for female students; (3) the average improvements in Asian, White, and Other (including African-American, Hispanic or Latino, Native American, Two or More) students are 1.36, 1.30, and 0.75, respectively, and the P-values of the improvements in Asian, White, and Other students are 2.655E-05 < 0.10, 0.0009479 < 0.10, and 0.02791 < 0.10, respectively, which shows that the improvements for all student ethnicity groups are statistically significant. However, the improvement is more significant for Asian and White groups than the Other group.

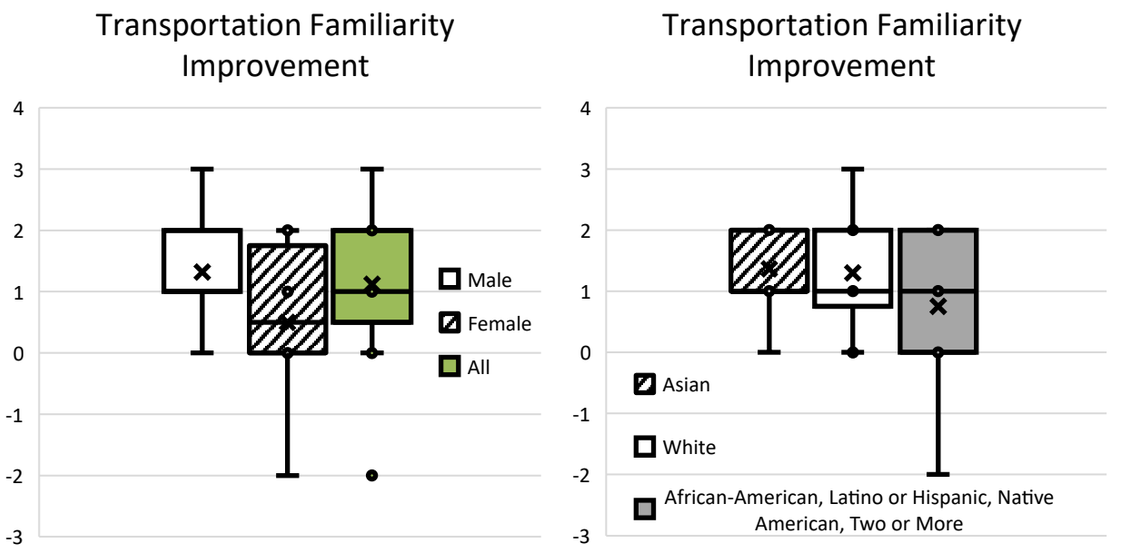

Fig. 3. Box and whisker plots showing the improvement of students' familiarity with transportation knowledge.

Table 1. Analytical statistics and the t-test results of improvement in transportation familiarity by genders and ethnicities.

	Gender			Ethnicity		
	Male	Female	All	Asian	White	Other
Mean	1.32	0.50	1.12	1.36	1.30	0.75
StDev	0.80	1.31	0.99	0.67	0.95	1.22
t-Test p-value	9.549E-09 < 0.10	0.1579 > 0.10	1.323E-07 < 0.10	2.655E-05 < 0.10	0.0009479 < 0.10	0.02791 < 0.10
Statistically Significant Improvement?	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**

Transportation Career Interest Improvement

Figure 4 shows the box and whisker plots of the transportation career interest improvements comparing males, females, and all (male + female) and Asian, White, and Others, respectively. Table 2 summarizes the analytical statistics and the t-test results to show if an improvement is statically significant compared to 0.

It can be observed that (1) the average overall improvement is 0.33 and the P-value is 0.05087 < 0.10, which shows that the summer program activities can significantly improve the students' interest in transportation career; (2) the average improvements in male and female students are 0.44 and 0, respectively, and the P-values of the improvements in male and female students are 0.03070 > 0.10 and 0.5000 > 0.10, respectively, which shows that the improvement for male students is statistically significant, but there is no improvement for female students; (3) the average improvements in Asian, White, and Other students are 0.82, 0.30, and -0.08, respectively, and the P-values of the improvements in Asian, White, and Other students are 0.002366 < 0.10, 0.1394 > 0.10, and 0.4256 > 0.10, respectively, which shows the improvement for the Asian student group is statistically significant, but, it is not significant for the White group. The Other group's interest decreased.

Conclusion

The objective of this research was to collect data and conduct analysis for transportation career awareness and diverse workforces through summer camp activities. The following research questions and answers are summarized below:

1. Can summer camp activities, in a short time, effectively improve the familiarity with transportation knowledge among secondary school students? Yes, transportation-focused summer camp activities can significantly (statistically) improve the students' familiarity with transportation knowledge.
2. Can summer camp activities, in a short time, effectively improve the interest in transportation careers among secondary school students? Yes, transportation-focused summer camp activities can significantly (statistically) improve the students' interest in transportation careers.
3. For the diverse workforce, do gender and ethnicity impact career awareness results? Yes, students' gender does have a significant impact on career awareness results. The improvement among male students is statistically significant and is significantly higher than among female students. And yes, students' ethnicity does have a significant impact on career awareness results. The improvement among Asian and White student groups is more significant and is significantly higher than among the Other student group (African-American, Latino or Hispanic, and Native American).

Future Research Direction

Transportation-focused summer camp activities worked very well for student transportation career awareness. However, it seems that these activities work better for male students, Asian, and White students. More specific activities designed for the involvement of female students, African American, Latino/Hispanic, and Native American students will be designed and added, such as involving student organizations such as the National Society of Black Engineers and the Society of Hispanic Professional Students.

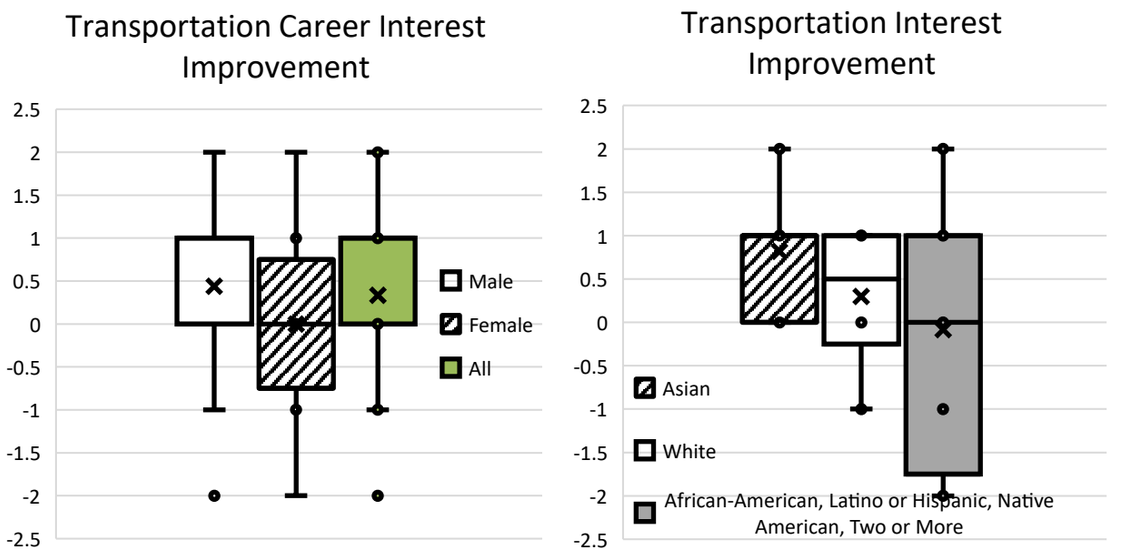

Fig. 4. Box and whisker plots showing the improvement of students' interest in transportation careers.

Table 2. Analytical statistics and the t-test results of improvement in transportation career interest by genders and ethnicities.

	Gender			Ethnicity		
	Male	Female	All	Asian	White	Other
Mean	0.44	0	0.33	0.82	0.30	-0.08
StDev	1.12	1.20	1.14	0.75	0.82	1.51
t-Test p-value	0.03070 < 0.10	0.5000 > 0.10	0.05087 < 0.10	0.002366< 0.10	0.1394> 0.10	0.4256 < 0.10
Statistically Significant Improvement?	**Yes**	No	**Yes**	**Yes**	No	No

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Biographies

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MAURIZIO MANZO is an associate professor in the Department of Mechanical Engineering at the University of North Texas and the program director of the 2022 NSTI and 2023 STI summer programs. Dr. Manzo got his PhD from Southern Methodist University, Dallas, Texas, in 2015, and both bachelor's and master's degrees in aerospace engineering from Italy. During his training, he has worked on different research areas of mechanical engineering such as experimental optics, photonics and sensing, and experimental fluid mechanics. He has authored several referred journal papers, and conference proceedings, and has 2 US patents (1 utility and 1 provisional). He is a member of the American Optical Society, the American Society of Mechanical Engineering, The Italian Association of Aeronautics and Astronautics, and the American Society for Engineering Education.