

Proliferating Transportation-Related Careers Through the National Summer Transportation Institute (NSTI)

Chris McGinn

North Carolina Central University

Timothy Mulrooney

North Carolina Central University

Rick-Kia Howard

North Carolina Central University

Tysean Wooten

North Carolina Central University

It is difficult to find a more diversified field than the transportation sector. Having a successful and viable transportation network requires upkeep of the physical infrastructure, grounds and machinery to enable travel over land, rail, air and water, the development of technologies in support of more efficient and safe travel as well as the digital foundation and skills to facilitate decision-making. In addition to the wide range of skills required within this field, long-range transportation planners must account for skills and technologies that are required at the current time, as well as those that do not even exist yet. With relatively newer technologies such as autonomous vehicles, smart cars, global positioning systems, high-speed rail networks, gyroscopic vehicles and high-precision logistics, transportation planners must be forward-thinking to ensure these technologies seamlessly integrate with current skillsets while replacing existing transportation positions that are being vacated by an increasingly higher number of workers as the baby-boomer generation reaches retirement age.

In response to these current and future needs, the Federal Highway Administration (FHWA), with support from the North Carolina Department of Transportation (NCDOT), developed the National Summer Transportation Institute (NSTI) as a means to expose middle and high school students to transportation-related careers through classroom instruction, field experience and enhancement activities designed to foster soft-skill development. During the Summer of 2018, North Carolina Central University (NCCU) was provided funding by the FHWA and NCDOT to offer a 2-week commuter NSTI camp in July of 2018. Eighteen students, among them seventeen minority students and seven women, applied for and were accepted for this summer's camp. In addition to classroom instruction and enhancement skills, students took a trip of the new light rail network route planned for the Chapel Hill-Durham region, visited the North Carolina Transportation Museum via an Amtrak train, rode bicycles on the American Tobacco Trail and visited the Division of Aviation at the NCDOT as a sample of the various modes of transportation. The camp culminated in group presentations by the students that addressed a transportation-related problem in the state. For example, one group used an Unmanned

Aircraft Vehicle (UAV), or drone, to monitor traffic around the NCCU campus while another group used Geographic Information Systems (GIS) to find solutions to the parking issues on the NCCU campus. Pre-camp and post-camp surveys highlighted students learned and retained the concepts, terms and places covered during the camp while open ended questions accentuated their preparation for the upcoming academic year. It is hoped that this camp can encourage high-school aged students, especially those from underrepresented groups, towards transportation-related careers and provide them with the technical acumen and soft-skills to be successful transportation professionals.

Introduction

Careers in transportation rely on the understanding of the technical and soft skills necessary to be successful transportation professionals. Part and parcel to understanding these skills is an exposure to all different modes of transportation available to residents of the state of North Carolina. North Carolina has more than 2,000 miles of limited-access highways among its more than 90,000 miles of paved roads which traverse almost 22,000 vehicular bridges. North Carolina also maintains more than 139 rail facilities and 4,800 rail crossings along 5,186 miles of railroads. More than 50 airports, including four international airports, support private aircraft and more than 27 million passenger boarding's every year. Eight ferry terminals provide ferry service up and down the coast of North Carolina and almost 7,000 miles of bicycle routes and numerous greenways fall under the full or partial responsibility of the North Carolina Department of Transportation (NCDOT).

In addition, the NCDOT engages in initiatives related to safe, efficient and environmentally-friendly transportation. These initiatives and programs that fall under the auspices of the NCDOT include rest areas, green energy, litter management, environmental monitoring, the regulation of Unmanned Aircraft Systems (UAS), state maintenance operations, work zone and safety, rail and highway safety, education initiatives, information technology, construction, construction planning and even drawbridges. Some careers related to the transportation industry have or will have pressing needs in the near future. According to the Bureau of Labor Statistics, careers directly related to the transportation industry as well as ancillary fields listed above such as environmental scientists, environmental engineers, civil engineers, urban planners, mapping technicians, geoscientists and

water transportation workers have excellent outlooks and are experiencing "as fast as average" or "faster than average" growth. (Bureau of Labor Statistics 2018). Other related fields such as green energy workers, operations research analysts and information research scientists have a "much faster than average" job outlook (Bureau of Labor Statistics 2018).

In response to this demand, the Headquarters for Civil Rights (HCR) of the Federal Highway Administration developed the NSTI as a means to "address future transportation workforce needs by ensuring that the transportation industry has a well-trained qualified and diversified workforce" (Federal Highway Administration 2018). Working with the state-level organizations, the team request proposals from universities throughout the state to host an NSTI site. Objectives of the program include 1) Improve STEM (Science, Technology, Engineering and Mathematics) skills 2) Provide awareness about transportation-related careers 3) Encourage students to consider transportation-related fields of study in higher education and 4) Commit significant program time to classroom instruction. While no specific guidelines are in place, HCR encourages "encourages outreach to the target groups who are under-represented in the transportation workforce (i.e., minorities, females, socially economically disadvantaged individuals, students with disabilities)." In addition to exploring the careers and related technical skills in the transportation fields, another goal of the NSTI is the enhancement program that introduces students to methods to activities to improve study habits, promote academic achievement and foster self-awareness (Federal Highway Administration 2018).

As a result, the Department of Environmental, Earth and Geospatial Sciences (DEEGS) at North Carolina Central University (NCCU), a Historically Black

College and University (HBCU) located in Durham, North Carolina, applied for and was approved to host an NSTI site for the summer of 2018. NCCU is composed of 6,339 undergraduate students, 82% (5,198) of whom are minorities including 78% African-American, 2% Hispanic and 1.5% Asian. Furthermore, over 60% of the total undergraduates enrolled at NCCU are female, highlighting the diversity-rich community on campus. NCCU is a leading minority-serving institution in regard to retention and graduation rates, peer assessment, faculty resources, student selectivity, financial resources and alumni giving. NCCU is recognized in the North Carolina community for its competitive research and educational programs, ranks in the top ten among HBCUs by College Choice, and ranks in the top twenty in Washington Monthly magazine's annual College Guide and Rankings list of the Best Bang for the Buck Colleges in the Southeast. NCCU was named the third-highest rated public HBCU in the country for 2018 by the annual U.S. News & World Report (2018).

The aim of the Department of Environmental, Earth and Geospatial Sciences is to develop in students the analytical and methodological skills necessary to understand the earth's environment and society's impact on the environment. The DEEGS offers coursework in the earth sciences, sustainability, geography, geospatial techniques, natural resources and environmental science. Despite a relatively tight job market, a degree in the DEEGS at North Carolina Central University has a diversified set of job prospects, ranging from urban planners and environmental scientists to geophysicists, many of which can be related to the transportation industry.

Underrepresented minority students face numerous socio-economic challenges in addition to many times having academic struggles in public schools and colleges. Across the United States., large numbers of disadvantaged students are affected by one or more risk factors (e.g. single parent, low parental education, underemployed/unemployed parent(s), residential frequent changes, etc.) that have been linked to academic failure and poor health (Robbins, Stagman, and Smith 2012). Chief among these factors is family economic hardship, which is consistently associated with negative outcomes in these two factors (Schlee, Mullis, and Shriner 2009).

North Carolina is in among the top 12 states having the highest percentage of young children living in extreme poverty with single-parent households (Robbins, Stagman, and Smith 2012). Poverty does not affect all demographic groups equally but for all individuals, families, and communities impacted by poverty, the problems often result in similar educational, career, and health outcomes. Impoverished populations are limited by their lack of access to economic and social resources that routinely manifest in underfunded education and limited food access.

Durham, and surrounding regions, have seen significant increases in the percentage of people living in poverty since 2000. Large HBCUs such as NCCU can leverage existing successful STEM recruitment programs to expand capacity for those who are marginalized in local HBCU underserved communities and build networks to integrate compatible Geospatial technologies such as GIS (Geographic Information Systems) and RS (Remote Sensing) into transportation-related fields.

Disadvantaged youth may have no or fewer positive adult role models in their lives. The high school years are a pivotal time in the development of student behaviors, attitudes, and work habits. The influence of family status variables (family income, parental education, and family structure), peer support, and neighborhood risk is a strong factor in predicting African-American performance in high school students. Furthermore, 2016 Census Bureau data tell us that minorities are graduating from high school at a lesser rate, and those who do complete high school are less likely to immediately enroll in a two-year or four-year institution (Tinto 1993). The data also tell us that they are even less likely to become STEM majors, and these effects are multiplied for women. These trends are made even more troubling in light of projected race/ethnic shifts in the US population (Gonzales et al. 1996; Harper and Griffin 2011). Therefore, an ecological approach is very important when addressing the problem of academic underachievement within the African-American community (Gonzales et al. 1996; Gorham-Smith, Tolan, and Henry 2000).

The Camp

Through the NCDOT and FHWA, NCCU applied for and was accepted to host an NSTI site for the Summer of 2018. This camp was intended for rising high school students (as of Fall 2018). Eighteen students were accepted for the camp, which ran from 8:30 AM through 4:30 PM on weekdays from Monday, July 9th through Friday, July 20th. Seventeen of the eighteen campers were minority students whose ages ranged from 13 to 17. Of the eighteen students, seven were female and eleven were male. Fifteen of the eighteen students were residents of Durham County and four of the students attended Josephine Dobbs Clement



Figure 1. Campers ride the Amtrak train from Durham to the North Carolina Transportation Museum near Salisbury.

During the first week of camp, campers took three transportation-related field trips. On Wednesday, July 11th, employees from GoTriangle, a local transportation planning organization, spoke to students about the proposed light rail project connecting Chapel Hill and Durham, with the one of the originating points being the NCCU campus. Students and staff took a driving tour of the proposed route, slated to begin construction in 2020, as well as a few of the proposed 18 stops along the route. On Thursday, July 12th, students took an Amtrak train from Durham to Salisbury to visit the North Carolina Transportation Museum located in Spencer, just north of the Salisbury (Image 1). On Friday, Dale McKeel, Bicycle and Pedestrian Coordinator for the City of

Early College High School, a high school located in the NCCU campus. Students in the early college attend grades 9 and 10 at a building on campus. For grades 11 and 12, students attend NCCU undergraduate classes and when these students graduate from the early college, they will already have transferable college credits.

Activities

NCCU worked hard to develop curriculum that covered the various modes of transportation, such as train, light rail, biking, driving, planes and ferries during the course of the camp.



Figure 2. Campers bike the American Tobacco Trail from the NCCU campus to downtown Durham.

Durham, spoke to campers about the many greenways that provide bicycle and pedestrian to the neighborhoods of Durham. After that, students rode bicycles from the NCCU and campus to downtown Durham on the American Tobacco Trail, a 22-mile pedestrian and bicycle trail that connects downtown Durham with Chatham County to the south (Image 2).

During the second week of camp, students took another two field trips. On Monday July 16th, campers visited Raleigh Durham International Airport's (RDU) observation deck and then visited the NCDOT Division of Aviation Headquarters. At the Division of Aviation, campers saw and toured one of the two planes that the NCDOT Division of Aviation owns and operates. One of the planes was used to

transport NCDOT personnel while students toured the NCDOT-owned plane that the NCDOT uses to collect imagery (Image 3). On Wednesday and Thursday (July 18th – 19th), campers took an overnight trip to the Outer Banks to visit the Wright Brothers Monument at Kitty Hawk, the site of the first successful and sustained flight by a heavier-than-air machine. After staying overnight in the Outer Banks, students took a ferry that crosses the Pamlico River on their way back to Durham.

In support of the commitment to provide quality classroom instruction to campers, classroom lessons focused on NCCU and DEEGS specialties to include Geographic Information System (GIS), Environmental

Stewardship, Mapping, Cultural Geography, Transportation Geography and the Use and Application of an Unmanned Aircraft System (UAS), or drone. Students collected imagery using a UAS and some students used a UAS to address a transportation-related problem.

As previously mentioned, and as part of the enhancement program, students were broken into groups and presented with a transportation related-problem. Students used or created their own data to develop a hypothesis, analyze the data and present results to the entire camp related to this problem. These presentations culminated the camp during the last session on camp on July 20th.



Figure 3. Campers visit the NCDOT Division of Aviation headquarters and toured the plane used to collect imagery throughout the state.



Figure 4. Campers work on their final presentation with NCCU undergraduate student Rick Kia Howard.



Figure 5. An image of the NCCU NSTI campers as captured from a UAS.



Figure 6. UAS imagery collected of the NCCU campus by NSTI campers.

Assessment and Evaluation

As part of the assessment and evaluation portion of the camp, students were given a pre and post camp survey that covered various facets of transportation, geography, people, places, activities and technologies covered throughout the course of the workshop. This helped to reinforce the concepts learned in classroom instruction, the enhancement activities as well as the

field trips. Soon after camp commenced on Monday, July 9th, 18 campers took the pre-camp survey. When the camp concluded on Friday, July 20th, 16 campers retook the survey using these same questions. Two students were not present to take the post-survey. Questions and assessment of the them are included below.

Table 1. Results of pre-camp and post-camp survey taken by campers covering the terms, concepts and places addressed during the NSTI camp.

Question	Correct Answer	Pre-Test %	Post-Test %
Another more formal name for a drone is a(n) _____.	Unmanned Aircraft System	22.2%	68.75%
What NCDOT division is responsible for dictating the laws on the prudent use of drones in the state of North Carolina?	Division of Aviation	55.6%	87.5%
The maximum elevation (above ground level) that you can fly a drone without a waiver is _____ feet.	400	61.1%	81.25%
In Geographic Information System (GIS) technologies, a(n) _____ is a type of question that we can ask the database.	Query	44.4%	62.5%
In our phones or web maps, the process of typing in an address and a physical location being displayed on the map is called _____.	Geocoding	44.4%	50%
In our phones or web maps, the process of connecting 2 locations using an algorithm such as the shortest travel time is called _____.	Networking	27.8%	56.25%
In an airport, the physical building from where people embark and disembark from airplanes is called a(n) _____.	Terminal	94.4%	93.75%
A boat used to carry passengers, cargo and even vehicles is called a _____.	Ferry	88.9%	93.75%
The _____ Brothers are credited with the first successful, sustained power flights in heavier-than-air machines in 1903.	Wright	88.9%	100%
The North Carolina Transportation Museum is located just north of the railroad terminal near the city of _____.	Salisbury	66.67%	100%
As of now, the Triangle Light Rail project will connect the cities of _____ and _____.	Chapel Hill and Durham	38.89%	62.5%
The _____ serves as a bike conduit between downtown Durham and the North Carolina Central University campus as well as points south to Chatham County.	American Tobacco Trail	55.56%	100%

From the results, response rates for all but one of these questions improved between the beginning and end of camp. These results are promising, as they helped reinforce the three-pronged curriculum focused on classroom instruction, field experiences and enhancement activities as intended by the NSTI.

Other Survey Results

During the post-camp survey, students were also asked questions about their response to their experiences and preparation for the upcoming school year as well as their desire to pursue transportation-related careers.

Table 2. Responses to field experiences and interest in transportation-related careers addressed in NSTI camp.

	Yes	No	Not Sure
Before this workshop, have you ever ridden on a train before?	8	8	0
Before this workshop, have you ever taken a ferry before?	5	11	0
Before this workshop, have you ever visited an airport before?	14	2	0
Before this workshop, have you ever walked or ridden on the American Tobacco Trail before?	5	9	1
Before this workshop, have you ever flown a drone before?	7	9	0
Are you interested in a career in transportation?	5	3	8

Lastly, students were asked open-ended questions about the academic and enhancement activities as they related to transportation careers. A sample of their answers are as follows (Tables 3, 4 and 5).

Table 3. Feedback regarding academic preparation for the next year.

In what area do you feel this camp has prepared you for the upcoming school year?
"This camp has helped me for the upcoming school year by enhancing my presentation skills."
"Technology and my project skills and managing my time."
"Get back in the feel of engaging and asking questions."
"How to project my voice when I'm talking and presenting."
"My PowerPoint skills are better and I am better with public speaking."

Table 4. Feedback regarding the understanding of transportation industry technical skill needs.

Briefly describe some of the technical skills that you would need to be successful in the transportation industry.
"Learning different things about maps and the data that we can put on them. We also learned about different types of transportation and different jobs within them."
"Skills such as knowing about GIS and engineering."
"Knowing how to read and understand a map."
"Depending on what job you are working at, computer skills are essential to a career in transportation."
"In the transportation industry you should know how to decode maps and pinpoint different locations."

Table 5. Feedback regarding other needs.

Briefly describe some of the soft (non-technical) skills that you would need to be successful in the transportation industry.
"Communication and Leadership Skills"
"In the transportation industry you should know how to communicate with your co-workers and be able to understand them."
"Adaptation because many of the speaker's said that most days you don't do the same thing they did."
"Creative thinking, ability to work with others, analytical thinking and speaking in front of others."
"Good public speaking skills and the ability to talk confidently in front of crowds."

Conclusions

The National Summer Transportation Institute is an initiative by the Federal Highway Administration to expose middle and high school aged students to transportation-related careers using a combination of field experiences, classroom instruction and enhancement activities and perpetuate STEM principles and how they can be applied in transportation-related fields. With support from the

NCDOT, North Carolina Central University was provided with funding to host an NSTI site during the summer of 2018 on the campus of NCCU in Durham, North Carolina. Eighteen high school-aged students were accepted for the day program, which ran daily from July 9th through July 20th.

The camp consisted of a combination of day trips, overnight field trips, classroom instruction by university professors, problem-solving activities using

STEM principles, talks by members of the transportation workforce and eventually culminating in group presentations in front of the camp where students solved a transportation-related problem related to Durham and the state of North Carolina.

Using basic assessment techniques such as evaluating pre and post-test results of the terms, places and concepts covered during camp, it was found that students learned and retained the information covered across the field experiences, enhancement activities and classroom learning. Open-ended questions answered by the students highlighted preparation for the upcoming school year via enhancement activities as well an understanding of the technical skills and STEM principles necessary to be successful in today's ever-evolving transportation industry.

Discussion and Moving Forward

Reception from both campers and parents highlighted satisfaction in the premier year of NCCU's version of the NSTI. The NSTI given by the Department of Environmental, Earth and Geospatial Sciences at NCCU focused classroom instruction around departmental strengths such as Geography, Geographic Information Systems, Environmental Science and the Earth Sciences. This differs from other NSTI programs hosted by varying departments such Civil Engineering Departments (California State University – Los Angeles), Transportation (Cal Poly Pomona) and Technology (Elizabeth City State University), as well are larger entities such as colleges and centers like the College of Business and Economics (North Carolina A&T State University), Diverse Business Supportive Services Center (Cheyney University), Institute for Human Development (University of Missouri – Kansas City) and the Center for Transportation Studies (University of Minnesota).

Future iterations of this camp will look to expand on field experiences, enhancement activities and classroom learning to engage more of NCCU community and play upon on a much wider variety of skillsets. Other non-DEEGS NCCU majors such as law, criminal justice, public administration, computer science, mathematics, business, physics and chemistry can have an impact on the transportation industry, whether it be the testing of new and more

durable highway materials, programming algorithms for autonomous vehicles, environmental testing of construction sites to ensure they meet mandated standards and the interpretation of UAV legislation for the lawful and prudent use them. Through these results and feedback, it is anticipated and expected that future NSTIs given by NCCU can provide underrepresented high-school students with the understanding, confidence and acumen to pursue careers in this ever-changing field.

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References

- Bureau of Labor Statistics.** 2018. Quick facts and summary of STEM and transportation-related fields. *Occupational outlook handbook: U.S. Department of Labor.* Accessed August 26, 2018. <https://www.bls.gov/ooh/>.
- Federal Highway Administration.** 2018. Frequently asked questions. *Summer transportation institute program.* Accessed September 1, 2018. https://www.fhwa.dot.gov/civilrights/programs/nsti_faq.cfm.
- Gonzales, N. A., A. M. Cauce, R. J. Friedman, and C. A. Mason.** 1996. Family, peer and neighborhood influences on academic achievement among African American adolescents: One-year prospective effects. *American Journal of Community Psychology* 24 (365):365–387. doi: 10.1007/BF02512027.
- Gorman-Smith, D., P. H. Tolan, and D. B. Henry.** 2000. A developmental-ecological model of the relation of family functioning to patterns of delinquency. *Journal of Quantitative Criminology* 16 (2):169–198. doi: 10.1023/A:1007564505850.
- Harper, S. R., and K. A. Griffin.** 2011. Opportunity beyond affirmative action: How low-income and working class Black male achievers access highly selective, high-cost colleges and universities. *Harvard Journal of African-American Public Policy* 17 (1):43–60.
- Robbins, T. A., S. M. Stagman, and S. Smith.** 2012. Young children at risk: National and state prevalence of risk factors. National Center for Children in Poverty. New York, NY. <https://academiccommons.columbia.edu/doi/10.7916/d8-ssf4-cm09>.
- Schlee, B. M., A. K. Mullis, and M. Shriner.** 2009. Parents' social and resource capital: Predictors of academic

achievement during early childhood. *Children and Youth Services Review* 31 (2):227–234. doi: 10.1016/j.chilyouth.2008.07.014.

Tinto, V. 1993. *Leaving College: Rethinking the causes and cures of student attrition*. Chicago, IL: University of Chicago Press.

U.S. News and World Report. 2018. Best historically black colleges and universities. *U.S. News—Education*. Accessed August 28, 2018. <https://www.usnews.com/best-colleges/rankings/hbcu>.