

## **Early Exposure/Long-Term Gains: Encouraging High School Students to Pursue STEM Degrees and Careers**

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The underrepresentation of African Americans in science, technology, engineering, and mathematics (STEM) fields in the United States is well documented. Statistics show that while African Americans make up 12.4% of the U.S. population, only 37% of African American 18–24-year-olds are enrolled in college, 45.9% complete their degrees within six years, and they earn only 7% of STEM bachelor's degrees. To address this issue from an upstream approach, Tennessee State University (TSU) houses the Tennessee Minority University Research and Education Project (MUREP) Aerospace Academy, a program that aims to inspire underrepresented high school students to pursue STEM degrees and careers. The program provides experiential learning, culturally relevant STEM curricula, engagement with STEM professionals, and family empowerment sessions. The study used a quantitative survey design to investigate the program's impact. Research questions examined how many students the program exposes to National Aeronautics and Space Administration (NASA) STEM careers, the amount of culturally relevant STEM education provided, and the program's impact on students' STEM interest, identity, skills, and knowledge, as well as parents' awareness of STEM opportunities. Preliminary results indicate the program positively impacted students' attitudes and interest in STEM post-secondary subjects and careers.

*Keywords:* Early Exposure, STEM Careers, Underrepresented High School Students, Tennessee Minority University Research and Education Project (MUREP), STEM Degrees

### **Introduction**

The underrepresentation of African American students in science, technology, engineering, and mathematics (STEM) fields is a persistent challenge in the United States. According to the U.S. Census Bureau, African Americans make up 12.4% of the total U.S. population (Nicholas et al., 2021), yet they account for only 7% of STEM bachelor's degrees awarded (PEW, 2021). Furthermore, data from the National Center for Education Statistics show that only 37% of African American 18-to-24-year-olds are enrolled in college (The Condition of Education, 2020), and the six-year college completion rate for African American students is just 45.9% (United Negro College Fund, 2018). Additionally, minority and individual ethnicities such as African Americans, Hispanics, American Indians, and Alaska Natives remained underrepresented among STEM degree recipients in the United States (National Science Foundation, 2022).

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To address this underrepresentation in STEM preparation, Tennessee State University (TSU), a Historically Black College/University (HBCU) located in Nashville, Tennessee, has implemented the Minority University Research and Education Project (MUREP) Aerospace Academy, to initiate efforts to expose minority high school students to STEM curriculum and experiential learning experiences related to Aeronautics. The purpose and objectives are to encourage minority high school students to become interested and possibly pursue STEM related degrees and careers, especially those NASA related. The MUREP project aims to inspire and engage underserved and underrepresented high school students in STEM, with a particular focus on African American students. This study evaluates the effectiveness of the MUREP program in achieving its goals of increasing high school students' interest, knowledge, and pursuit of STEM degrees and careers after participating in the MUREP program. Hence, the overarching research question of this study is how effective was the MUREP program in generating interest in STEM degrees and career opportunities by the underserved and underrepresented high school students who completed the MUREP program?

This paper begins with an introduction that offers background information leading to the study. Following the introduction is a literature review that discusses the role and potential impact of STEM education in college and beyond. Next, there is an overview of the TSU MUREP Aerospace Academy program, detailing its critical components, including the Aerospace Academy, key initiatives, research questions, and theoretical framework. The Methodology section follows, outlining the data collection methods, data analysis procedures, and the results obtained from the analysis. Finally, the discussion and conclusion sections present the implications, recommendations, and overall conclusions of the study.

### **Literature Review**

The literature review examined the critical role of early exposure to STEM education in sparking student interest and pursuit of STEM careers, particularly for underrepresented minority groups. Research suggests that lack of early exposure to STEM careers is a significant barrier, as students need to be aware of these possibilities from a young age (Christensen & Knezek, 2017). This early exposure is especially important for middle and high school students, as it helps build a strong foundation for STEM-related skills and boosts academic achievement (STEM Education Works, 2021 and Valverde & Davidow, 2022).

However, studies show that African American and Hispanic/Latino adults are less likely to earn STEM degrees compared to their share of the population (Pew Research Center Report 2021, and Kennedy et al., 2021). Factors contributing to this disparity include weak math and science foundations, cultural barriers in college, and a lack of diverse STEM career pathways (March for Science, 2017). Informal STEM education programs have been identified as vital in providing early exposure and positive attitudes toward STEM subjects, which can contribute to long-term STEM interests and success (Cheryan et al., 2017; Demir et al., 2021). Programs like Club Invention and Boulder Builders, offered by the National Inventors Hall of Fame, have been successful in engaging students through hands-on, creative STEM experiences (National Inventors Hall of Fame, 2022).

Research also highlights the benefits of incorporating engineering and robotics concepts into K-12 STEM curricula, as they can foster skills like communication, critical thinking, and teamwork (Kimmel et al., 2014; Moreno, 2016). However, there is limited research on the impact of such programs on underrepresented minority students at the middle and high school levels.

Social research in STEM has shown the underachievement of certain underrepresented and racial/ethnic groups and women with little attention to the social determinants of the success of those individuals and social groups in STEM education, (Xie et al, 2015). The complexity of STEM education demands that we find ways to reduce the gap and underachievement seen in minority groups.

To address this gap, Tennessee State University has focused on STEM education initiatives targeting high school students in underserved communities of Nashville. The literature (Altman et al, 2019, O'Rourke, 2021, & Savoca et al, 2023) suggests that further research is needed to understand the powerful impact of early STEM exposure and its ability to inspire more underrepresented minority students to pursue STEM-related careers.

### **Program Overview: Tennessee MUREP Aerospace Academy**

The TSU MUREP program is a three-year initiative funded by the National Aeronautics and Space Administration (NASA) and is currently in its second year. Therefore, the preliminary results of the study will reflect data from the first year. A comprehensive assessment will be available once all three years of the study are completed.

Housed within TSU, the Tennessee MUREP Aerospace Academy seeks to tackle the significant underrepresentation of African American students in STEM fields. The academy focuses on four primary goals:

1. Inspiration: Motivate underserved students to pursue STEM education and careers.
2. Engagement: Involve students in hands-on STEM experiences using advanced technology to develop skills and knowledge.
3. Education: Deliver culturally relevant STEM curricula and evidence-based strategies.
4. Awareness: Increase awareness among students and their families about STEM opportunities, including internships, degrees, and professional skills.

### **Key Strategies**

The project's goals and objectives are executed through a year-round design. It provides STEM enrichment sessions via an out-of-school model that takes place on weekends and during the summer. These sessions are conducted in the spring, and summer, offering a minimum of 60 hours of STEM programming annually through six key strategies:

- 1) Experiential Learning Experiences: Hands-on activities that expose students to real-world STEM applications.
- 2) Aerospace Education Laboratory (AEL): Facilities equipped with state-of-the-art technology for aerospace-related experiments and learning.
- 3) Engagement with STEM Professionals: Interaction opportunities with professionals in STEM fields to provide mentorship and career guidance.
- 4) College and Career Readiness: Programs designed to prepare students for higher education and STEM careers.
- 5) Family Empowerment Sessions: Workshops and events aimed at educating families about STEM opportunities and supporting their children's educational journeys.
- 6) STEM Professional Development: Training sessions for educators to enhance their capabilities in teaching STEM subjects effectively.

### Research Questions and Associated Objectives

The research questions and objectives that guide this study are related to the MUREP program's impact on underserved and underrepresented students' interest in STEM fields and the parents'/guardians' knowledge and awareness of STEM degrees, internships, career awareness, and college preparation. Table 1 details all five research questions and each associated research objective.

Table 1. Research Questions and Associated Objectives

<p><b>Research Question 1:</b> How many underserved or underrepresented students does MUREP expose to NASA specific STEM careers each year?</p>
<ul style="list-style-type: none"> <li>• <i>Research Objective 1: To annually reach a minimum of 100 underserved and underrepresented students in the TSU MUREP program.</i></li> </ul>
<p><b>Research Question 2:</b> How many hours of culturally relevant STEM curricula and experiential learning sessions utilizing technology does the MUREP program provide?</p>
<ul style="list-style-type: none"> <li>• <i>Research Objective 2: To provide a minimum of 60 hours of culturally relevant STEM curricula and experiential learning sessions utilizing technology.</i></li> </ul>
<p><b>Research Question 3:</b> How does participation in the MUREP program impact students' expressed interest in STEM degrees and careers?</p>
<ul style="list-style-type: none"> <li>• <i>Research Objective 3: Throughout the 2022 – 2025 academic years, 50% of the participants will express interest in STEM post-secondary degrees after participating in the TSU MUREP program.</i></li> <li>• <i>Research Objective 4: Throughout the 2022 – 2025 academic years, 50% of the participants will express interest in STEM post-secondary careers after participating in the TSU MUREP program.</i></li> </ul>
<p><b>Research Question 4:</b> How does participation in the MUREP program enhance students' STEM identity, STEM skills, and STEM knowledge after participating in the TSU MUREP program?</p>
<ul style="list-style-type: none"> <li>• <i>Research Objective 5: Throughout the 2022 – 2025 academic years, 50% of the participants will enhance their STEM identity, STEM skills, and STEM knowledge after participating in the TSU MUREP program.</i></li> </ul>
<p><b>Research Question 5:</b> How does participation in the MUREP program increase parents'/guardians' knowledge and awareness of STEM degrees, internships, career awareness, and college preparation?</p>
<ul style="list-style-type: none"> <li>• <i>Research Objective 6: Throughout the 2022 – 2025 academic years, 50% of parents/guardians will participate in STEM empowerment sessions that increase their knowledge and awareness of STEM degrees, internships, career awareness, and college preparation.</i></li> </ul>

## **Theoretical Framework**

This study is grounded in the social cognitive career theory (SCCT), which posits that individuals' career-related interests, choices, and performance are influenced by their self-efficacy beliefs, outcome expectations, and personal goals (Lent et al., 1994). SCCT emphasizes the role of contextual factors, such as educational and community-based programs, in shaping individuals' career-related beliefs and behaviors.

The MUREP program is designed to align with the key components of SCCT, including:

1. Providing students with mastery experiences (e.g., hands-on STEM activities) to enhance their self-efficacy beliefs.
2. Exposing students to positive role models and successful STEM professionals to shape their outcome expectations.
3. Offering guidance and resources to help students set and achieve their STEM-related academic and career goals.
4. Fostering a supportive and inclusive learning environment that addresses the unique needs and cultural backgrounds of underrepresented minority students.

## **Methodology/Materials and Methods Results**

The study employed a quantitative survey research design to investigate the research questions. The target population was minority high school students in grades 9-12 who participated in the MUREP program.

### **Data Collection**

The data were collected using the MISO Student Attitudes Toward STEM (S-STEM) Survey for Middle and High School Students. The survey was administered to MUREP participants in grades (9th-12th). The survey measured students' attitudes, interests, and knowledge related to STEM education and careers, as well as their perceptions of the program's impact.

### **Measures**

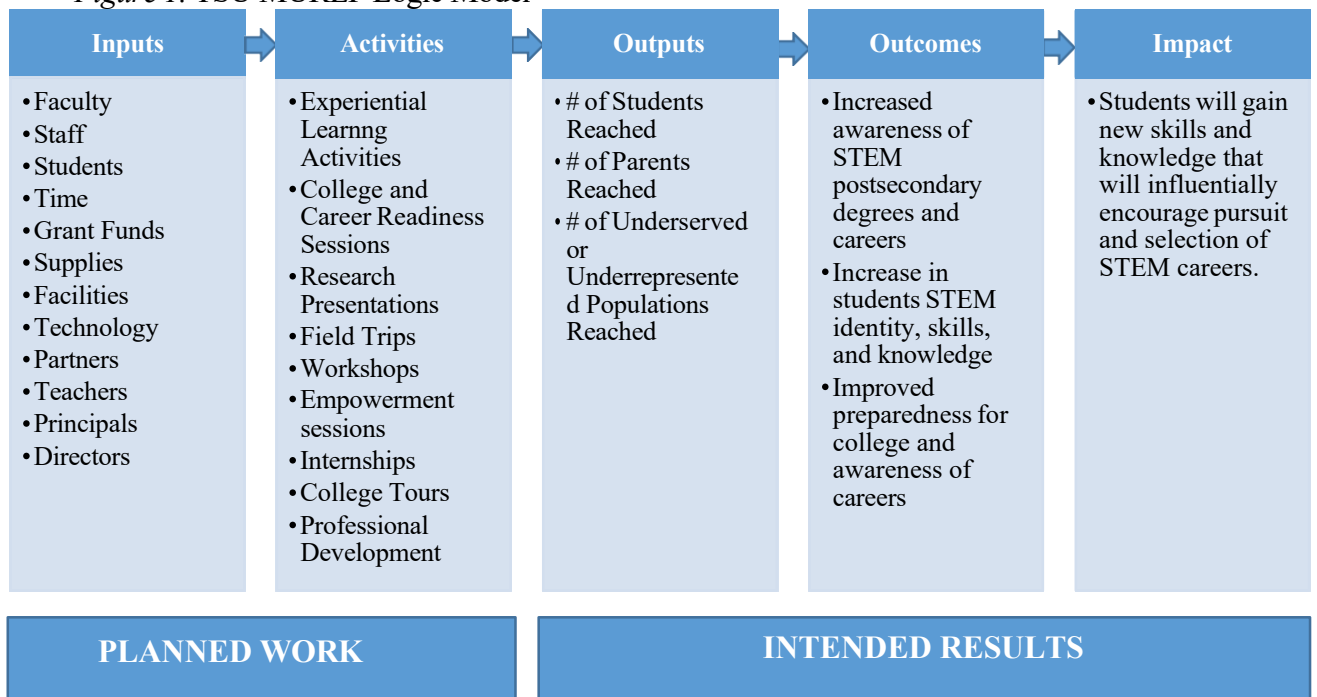
The survey included the following key measures:

1. Demographic information (e.g., age, gender, race/ethnicity)
2. STEM identity, skills, and knowledge
3. Interest in STEM degrees and careers
4. Exposure to specific STEM careers
5. Hours of culturally relevant STEM curricula and experiential learning
6. Parents'/guardians' knowledge and awareness of STEM opportunities

**Data Analysis**

The data were analyzed using a logic model (see Figure 1), which allowed the researchers to examine the relationships between the program's inputs, activities, outputs, and outcomes, and how they collectively contributed to the achievement of the program's goals and objectives. This study used a quantitative survey research design. According to Creswell and Guetterman (2019), "Survey research designs are a set of research procedures in which investigators administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behaviors, or characteristics of the population." This approach was used to survey African American high school students' attitudes and interests in STEM subjects and careers after participation in the MUREP project. To answer the research questions, a descriptive summary of the responses was done from which percentages and frequencies were generated and reviewed to provide answers to the research questions. Year 1 data represented the baseline or reference year while years 2 and 3 are the follow-up years. Inferential statistics including t-test and ANOVA will be conducted to assess the change in students' responses from year to year. The preliminary results presented here are only for the first year of the project. When the third year of the project is completed, the final assessment will be completed and presented.

Figure 1. TSU MUREP Logic Model



**Descriptive Findings and Results**

*Research Question 1:* How many underserved or underrepresented students does MUREP expose to specific STEM careers each year?

The TSU MUREP program provided 124 hours of curriculum enhancement sessions to high school students in Davidson County and surrounding areas. Specifically, the program has served five counties in Tennessee which include: Davidson County, Montgomery County, Rutherford County, Wilson County, and Williamson County. Table 2 below provides demographic information by county for direct participants during year one. Most of the participants reside in Davidson County (83%), an urban school district in Nashville, Tennessee, followed by Williamson County (7%), and Rutherford County (6%), suburban school districts.

*Table 2. Demographic Information by County for Direct Participants*

	# of Students (Spring)	# of Students (Summer)	Total Students
Davidson County	24	64	88
Rutherford County	3	4	7
Montgomery County	1	0	1
Wilson County	1	0	1
Williamson County	6	2	8
Total	35	70	105

### Demographic Statistics of MUREP Participants

The TSU MUREP program offered STEM experiential learning opportunities during the Spring and Summer sessions. All lessons and activities were held utilizing face-to-face teaching and learning. The tables below provide demographic information of TSU direct participants for the 2023 Spring and Summer Sessions.

Table 3 below provides a detailed breakdown by gender and ethnicity for the Spring STEM Academy. Sixty-two (62%) percent of males were Black/African American, and sixty-four (64%) percent of the females were Black/African American. A total of sixty-three (63%) percent of the participants were Black/African American. The second largest group was Asian (11%) and tied for the third largest group was Hispanics or persons with Two or More Races (8%) respectively. There were (6%) of participants who did not identify their ethnic background. Overall, ninety-four (94%) of the participants were from various minority ethnicities.

*Table 3. Demographic Breakdown by Ethnicity and Gender (Spring 2023)*

Ethnicity	Male	Female	Total
Black or African American	13	9	22
Asian	3	1	4
American Indian or Alaska Native	1	0	1
White	0	0	0
Hispanic/Latinx	2	1	3
Two or More Races	2	1	3
Native Hawaiian or Pacific Islander	0	0	0
No Responses	0	2	2
Grand Total	21	14	35

Table 4 below provides a breakdown of gender and grade level for the Spring STEM Academy. TSU MUREP reached a total of 35 high school students during the 2023 spring sessions. Sixty (60%) percent of participants were males, and forty (40%) percent were females. Most participants, forty-nine (49%) percent, were in 9<sup>th</sup> grade.

*Table 4. Demographic Breakdown by Gender and Grade Level (Spring 2023)*

Gender	9 <sup>th</sup> Grade	10 <sup>th</sup> Grade	11 <sup>th</sup> Grade	12 <sup>th</sup> Grade	Grand Total
Male	10	7	2	2	21
Female	7	2	1	4	14
Grand Total	17	9	3	6	35

Table 5 below provides a detailed breakdown by gender and ethnicity for the 2023 Summer STEM Academy. Seventy-six (76%) percent of males were Black/African American, and sixty-eight (68%) percent of the females were Black/African American. A total of seventy-three (73%) percent of the participants were Black/African American. The second largest group was Other (10%) and the third largest was persons with Two or More Races (6%). Overall, ninety-seven (97%) percent of participants were from various minority ethnicities.

*Table 5. Demographic Breakdown by Ethnicity and Gender (Summer 2023)*

Ethnicity	Female	Male	Total
Asian	2	1	3
Black or African American	19	32	51
Hispanic/Latino	1	2	3
Other	3	4	7
Two or More Races	2	2	4
White (non-Hispanic)	1	1	2
Total	28	42	70

Table 6 below provides a breakdown of gender and grade level for the Summer STEM Academy. TSU MUREP reached a total of 70 high school students during the 2023 summer session. Sixty (60%) percent of participants were males, and forty (40%) percent were females. Most participants, thirty-seven (37%) percent were in 9<sup>th</sup> grade.

*Table 6. Demographic Breakdown by Gender and Grade Level (Summer 2023)*

Gender	9 <sup>th</sup> Grade	10 <sup>th</sup> Grade	11 <sup>th</sup> Grade	12 <sup>th</sup> Grade	Total
Female	9	10	3	6	28
Male	17	8	11	6	42
Total	26	18	14	12	70

*Research Question 2:* How many hours of culturally relevant STEM curricula and experiential learning sessions utilizing technology does the MUREP program provide?

The goals of the TSU MUREP project are to inspire, engage, educate, and increase high school students and their families' knowledge about STEM subjects and careers.



One of TSU's objectives is to annually expose a minimum of 100 underserved and underrepresented minority students to NASA specific STEM content. The MUREP program offered a total of 26 sessions and 124 hours of out-of-school outreach. The MUREP program provided an average of 120 hours of culturally relevant STEM curricula and experiential learning sessions utilizing technology per participant.

### STEM Curricula and Experiential Learning Sessions

- **Out-of-School Sessions:** The MUREP program has provided 16 sessions for a total of 84 hours of STEM related curriculum to high school students in Davidson County Tennessee and surrounding areas, through its 2022-2023 STEM initiatives. The program has reached a total of 105 students through Saturday and Summer sessions.
- **Family Empowerment:** The program provided three family empowerment sessions for a total of 6 hours.
- **Professional Development:** The program provided five professional development sessions to teachers and student leaders for a total of 16 hours.
- **College and Career Readiness:** The program provided three college and career readiness sessions to students for a total of 18 hours. See Table 7 below for the number of sessions and contact hours.

Table 7. STEM Curricula and Experiential Learning Hours

Strategy 1: Experiential Learning Activities	# of Sessions	Contact Hours
Out of School Session: Experiential Learning Activities Spring/Engagement with STEM Professionals	6	24
Out of School Session: Experiential Learning Activities (Summer Capstone)/Engagement with STEM Professionals	10	60
Professional Development	5	16
Family Empowerment	2	6
College and Career Readiness	3	18
Total	26	124

*Research Question 3:* (Linked to research objectives 3 & 4) How does participation in the MUREP program impact students' expressed interest in STEM degrees and careers?

- *Research Objective 3:* Throughout the 2022 – 2025 academic years, 50% of the participants will express interest in STEM post-secondary degrees after participating in the TSU MUREP program.

The program goal associated with this research question and research objective is for the MUREP program to provide an early college experience that offers sessions to high school students and their families focused on STEM degrees, internships, mentoring, career awareness, and professional skills. In this first year (2022-2023) of the TSU MUREP, the program was successful in reaching 105 underrepresented

minority students and their families. Throughout the year, data collection in the form of surveys and questionnaires was ongoing to collect the necessary data to provide summative evaluations of the effectiveness of the program's process, impact, and outcome. The participation and completion of the surveys and questionnaires are purely voluntary. Additionally, the response rates depend on the date and time of the execution of the surveys and questionnaires. The data collected for the remaining portion of the evaluation represented a 36% response rate in which only 38 of the 105 involved students completed the related surveys and questionnaires. While this 36% response rate is above the typical response rates of 10% - 30% for survey completion, efforts must be increased to incentivize students' participation to collect adequate data to truly measure program goals, objectives, and research questions.

Of the 38 students who completed the survey, 36 (7+29) or 94% agreed that the program activities expanded their knowledge and awareness of the STEM post-secondary degrees, see Table 8. This 94% rate of agreement among the 38 responders is not reflective of the entire involved student population of 105. While this 94% agreement rate (of the current responders) is above the targeted objective of 50%, it does not capture/reflect the agreement rate for all 105 involved students.

*Table 8. Students Expressed Interest in STEM Post-secondary Degrees*

	Frequency	Percent	Valid Percent	Cumulative Percent
Neither	2	5.3	5.3	5.3
Agree	7	18.4	18.4	23.7
Strongly Agree	29	76.3	76.3	100.0
Total	38	100.0	100.0	

- *Research Objective 4:* Throughout the 2022 – 2025 academic years, 50% of the participants will express interest in STEM post-secondary careers after participating in the TSU MUREP program.

Of the 38 students who completed the survey, 36 (11+25) or 94% agreed that the program activities led to their interest in STEM post-secondary careers, see Table 9. While this 94% agreement rate (of the current responders) is above the targeted objective of 50%, it does not capture/reflect the agreement rate for all 105 involved students.

*Table 9. Students Expressed Interest in STEM Post-secondary Careers*

	Frequency	Percent	Valid Percent	Cumulative Percent
Neither	2	5.3	5.3	5.3
Agree	11	28.9	28.9	34.2
Strongly Agree	25	65.8	65.8	100.0
Total	38	100.0	100.0	

*Research Question 4:* (Linked with research objective 5) How does participation in the MUREP program enhance students' STEM identity, STEM skills, and STEM knowledge after participating in the TSU MUREP program?

- *Research Objective 5:* Throughout the 2022 – 2025 academic years, 50% of the participants will enhance their STEM identity, STEM skills, and STEM knowledge after participating in the TSU MUREP program.

Of the 38 students who completed the survey, 35 (9+26) or 92% agreed that the program activities enhanced their STEM identity in better understanding their strengths and interests, see Table 10. This 92% rate of agreement among the 38 responders is not reflective of the entire involved student population of 105.

*Table 10.* Students Expressed Enhanced STEM Identify

	Frequency	Percent	Valid Percent	Cumulative Percent
Disagree	1	2.6	2.6	2.6
Neither	2	5.3	5.3	7.9
Agree	9	23.7	23.7	31.6
Strong Agree	26	68.4	68.4	100.0
Total	38	100.0	100.0	

Of the 38 students who completed the survey, 35 (10+25) or 92% agreed that the program activities enhanced their STEM skills, see Table 11. This 92% rate of agreement among the 38 responders is not reflective of the entire involved student population of 105.

*Table 11.* Students Expressed Enhanced STEM Skills

	Frequency	Percent	Valid Percent	Cumulative Percent
Neither	3	7.9	7.9	7.9
Agree	10	26.3	26.3	34.2
Strongly Agree	25	65.8	65.8	100.0
Total	38	100.0	100.0	

Of the 38 students who completed the survey 35 (10+25) or 92% agreed that the program activities enhanced their STEM knowledge, see Table 12. This 92% rate of agreement among the 38 responders is not reflective of the entire involved student population of 105.

Table 12. Students Expressed Enhanced STEM Knowledge

	Frequency	Percent	Valid Percent	Cumulative Percent
Neither	3	7.9	7.9	7.9
Agree	10	26.3	26.3	34.2
Strongly Agree	25	65.8	65.8	100.0
Total	38	100.0	100.0	

*Research Question 5:* (Linked with research objective 6) How does participation in the MUREP program increase parents'/guardians' knowledge and awareness of STEM degrees, internships, career awareness, and college preparation?

- *Research Objective 6:* Throughout the 2022 – 2025 academic years, 50% of parents/guardians will participate in STEM empowerment sessions that increase their knowledge and awareness of STEM degrees, internships, career awareness & college preparation.

The MUREP program efforts for 2022-2023 were able to successfully reach 105 underrepresented minority students and their families. Family involvement is a critical component of students' success and knowing this program included the Family Empowerment Sessions as their strategy. During the three hosted Family Empowerment Sessions, 18 parents/guardians participated. Of this total, 7 or 39% of parents/ guardians completed the survey/questionnaire. The participation and response rates to the survey/questionnaire completion by the parents/guardians were also low and presented one of the areas for improvement in year two of the MUREP program.

Of this total, 7 parents/guardians completed the survey/questionnaire. The participation and response rate to the survey/questionnaire completion by the parents/guardians were also low and presented one of the areas for improvement in year two of the MUREP program.

Of the 7 parents/guardians who completed the survey; 6 (1+5) or 85.7% agreed that the program activities expanded their knowledge and awareness of the STEM post-secondary degrees, see Table 13. This approximately 86% agreement among the 7 parents'/guardians' responders is not reflective of the entire involved population of parents and guardians. 7 of 18 parents represent a mere 39% rate of participation. While this 85.7% agreement rate is above the targeted objective of 50%, it does not capture/reflect the agreement rate for all 18 involved parents and guardians.

Table 13. Parents/Guardians Expressed Increase in Knowledge and Awareness of STEM Degrees

The college tours expanded my knowledge/awareness of STEM degrees					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly Disagree	1	14.3	14.3	14.3
	Agree	1	14.3	14.3	28.6
	Strongly Agree	5	71.4	71.4	100.0
	Total	7	100.0	100.0	

Of the 7 parents/guardians who completed the survey, 6 or 85.7% agreed that the program activities provided them with more knowledge/awareness of STEM careers, see Table 14.

*Table 14: Parents/Guardians' Response to how the Program provided them with more Knowledge/Awareness of STEM Careers*

The career awareness session provided me with more knowledge/awareness of STEM careers					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly Disagree	1	14.3	14.3	14.3
	Strongly Agree	6	85.7	85.7	100.0
	Total	7	100.0	100.0	

Of the 7 parents/guardians who completed the survey, 6 (1+5) or 85.7% agreed that the program activities expanded their knowledge and awareness of college preparation, see Table 15.

*Table 15: Parents/Guardians Expressed Expansion of their Knowledge/Awareness of College Preparation*

The college preparation session expanded my knowledge/awareness of how to prepare for college					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly Disagree	1	14.3	14.3	14.3
	Agree	1	14.3	14.3	28.6
	Strongly Agree	5	71.4	71.4	100.0
	Total	7	100.0	100.0	

## Discussion

The initial findings of this study demonstrate the effectiveness of the Tennessee MUREP Aerospace Academy in addressing the underrepresentation of minority students in STEM fields. By providing underserved and underrepresented high school students with extensive exposure to specific STEM careers, culturally relevant STEM curricula and experiential learning, and targeted support for students and their families, the MUREP program has made significant strides in inspiring and engaging these students to pursue STEM degrees and careers.

The positive impact on students' STEM identity, skills, and knowledge, as well as the increased awareness of STEM opportunities among parents and guardians, suggests that the program's holistic approach is crucial in fostering a supportive ecosystem for underrepresented minority students to succeed in STEM. These findings align with the social cognitive career theory, which emphasizes the importance of

contextual factors in shaping individuals' career-related beliefs and behaviors.

Given the potential impact and value of STEM education in helping to better prepare minority students for higher education and future careers, efforts to increase the response rate must be continued to capture a larger percentage of the participating students, parents, and guardians.

### **Implications and Recommendations**

The continued success of the Tennessee MUREP Aerospace Academy has several implications for educational institutions, policymakers, and community-based organizations seeking to address the STEM achievement gap among underrepresented minority students:

- Invest in comprehensive STEM outreach and enrichment programs that provide extensive hands-on learning experiences, exposure to STEM role models, and tailored support for students and their families.
- Prioritize the development and implementation of culturally relevant STEM curricula and pedagogical approaches that resonate with the experiences and backgrounds of underrepresented minority students.
- Foster partnerships between educational institutions, government agencies (e.g., NASA), and community organizations to leverage resources and expertise in supporting underrepresented minority students' STEM pursuits.
- Advocate for increased funding and policy initiatives that enable the expansion and sustainability of successful STEM programs, such as the Tennessee MUREP Aerospace Academy.

Black and Hispanic students are less likely to earn degrees in STEM than in other fields and are also underrepresented among those earning advanced STEM degrees. Additionally, Blacks and Hispanic professionals are underrepresented in STEM, compared with their share of the overall U.S. workforce, (Temming, 2021). Given these various under-representations, future research should explore the long-term impacts of the MUREP program, including students' college enrollment, persistence, and degree attainment in STEM fields. Additionally, qualitative investigations can provide deeper insights into the program's implementation, challenges, and the mechanisms through which it influences students' STEM identity, motivation, and career aspirations.

### **Conclusions**

The Tennessee MUREP Aerospace Academy has demonstrated the potential of comprehensive STEM outreach and enrichment programs to inspire and engage underrepresented minority students in STEM education and careers. By providing extensive hands-on learning experiences, culturally relevant curricula, and targeted support for students and their families, the MUREP program has positively impacted participants' STEM interests, knowledge, and pursuit of STEM degrees and careers. These findings underscore the critical role those educational institutions, government

agencies, and community partners can play in addressing the STEM achievement gap and fostering a more diverse and inclusive STEM workforce.

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