Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48964

Fostering STEM Engagement: Evaluating the Impact of the #GOALS Program on Middle-School Students' Interest and Motivation in Science and Technology

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Fostering STEM Engagement: Evaluating the Impact of the #GOALS Program on Middle-School Students' Interest and Motivation in Science and Technology (Evaluation)

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Abstract

The #GOALS (Go Out and Love Science) program, spearheaded by the Ascension Foundation for Health Equity, aims to engage middle school students from underserved communities and ignite their interest in healthcare careers. It is currently in its third year of implementation, rolled out at limited middle schools throughout the country. The program includes one-day events held at partner institutions such as Meharry Medical College, where students are exposed to various careers in STEM and medical fields.

This research examines how participation in the #GOALS program influences students' educational and career trajectories, with a particular focus on healthcare and STEM fields. The primary objective is to evaluate the program's effectiveness in increasing students' interest in healthcare careers and their engagement in STEM education, with additional researcher-designed interventions such as summer camps, mentorships, parental involvement, and field trips. Feedback from students, parents, and educators will guide continuous program refinement.

To understand the program's impact, the study will follow a cohort of middle school students over five to six years, assessing changes in career interests and academic achievements. Pre- and post-event data will be collected to measure both immediate and long-term effects. Surveys developed by the researchers and Ascension teams will capture shifts in student aspirations and performance at various stages of the program. Initial data will be gathered before each event to establish a baseline of students' attitudes, academic standing, and career interests. Follow-up data will be collected immediately after each event to gauge the event's influence on students' perspectives.

A long-term tracking system will monitor the academic progress and career development of students who complete the #GOALS program, enabling a comprehensive analysis of its lasting impact. This extended tracking will help determine how early exposure to healthcare and STEM fields affects long-term aspirations and outcomes. Several innovative approaches will be implemented to enhance learning and engagement. For example, the program will integrate Roblox to offer virtual learning experiences related to healthcare and science careers, while social platforms like Roblox and Snapchat will be used to provide students with timely updates on opportunities and program events. Recurring school information sessions, featuring guest lectures and Q&A sessions with professionals from medical and science fields, will be held every two months for grades 6-8 to ensure sustained exposure and engagement.

Key stakeholders, including the researchers, Ascension Foundation, participating schools, and educational partners such as Meharry Medical College, will support the program's implementation and evaluation. The anticipated outcomes of this study will highlight the influence of early exposure to healthcare and STEM on shaping students' long-term aspirations. By tracking their progress, the research will pinpoint which program interventions are most effective in fostering sustained interest in healthcare careers. The findings will inform strategies for enhancing and scaling the #GOALS program, making it more broadly applicable and impactful in promoting diversity within the healthcare workforce.

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An Introduction to #GOALS Program

The #GOALS (Go Out and Love Science) program, developed by the Ascension Foundation for Health Equity, is a transformative initiative designed to inspire middle school students from underserved communities to pursue careers in healthcare and STEM. The program's broader goal is to address systemic disparities in healthcare by creating a pipeline of diverse talent equipped to meet the needs of an increasingly diverse population (Betancourt et al., 2016). By promoting equity and inclusion in STEM education, #GOALS exemplifies a model for transformative change in preparing the next generation of healthcare professionals.

Now in its third year, the program has been implemented in select schools across the United States. These schools are brought into the program based on the demographics and college enrollment statistics for a given region. The program targets schools from predominantly minority populations and lower socio-economic status. No other information about the students can be disclosed due to privacy concerns.

#GOALS features one-day events at partner institutions such as Meharry Medical College. During these events, students are introduced to a wide range of careers in STEM and medical fields through hands-on activities, mentorship opportunities, and exposure to cutting-edge medical technology. This initiative addresses the urgent need to diversify the healthcare workforce, as research consistently shows that increased representation of minority groups in medicine leads to improved cultural competence and better health outcomes for underserved populations (Nelson, 2002; Nivet, 2011).

Through hands-on, immersive experiences, #GOALS introduces students to the diverse career possibilities within the medical and scientific fields. Participants engage in activities such as simulated surgeries, basic medical procedures, Q&A with medical school students, and interactive workshops, which give them a tangible understanding of the tools, technology, and practices used by healthcare professionals. The program also emphasizes mentorship, enabling students to connect with medical students, doctors, and other healthcare workers who share personal stories of overcoming challenges to achieve their goals. These interactions help students envision their own potential pathways into these careers, fostering both confidence and ambition. The program has had a transformative impact since its inception, reaching nearly 2,000 students in cities such as Nashville, New Orleans, and Detroit. Each event is carefully tailored to reflect the unique cultural and community context of its location, ensuring relevance and resonance for participants. For example, workshops and mentorship sessions often highlight local health disparities and the critical role diverse healthcare professionals play in addressing these issues. By spotlighting the importance of a healthcare workforce that mirrors the diversity of the communities it serves, #GOALS aims to build trust and equity in medical services. It underscores how diverse perspectives in medicine lead to better patient outcomes, particularly in underserved populations. The program also focuses on bridging gaps in education and opportunity, addressing systemic barriers that have historically limited access to STEM fields for students from under-resourced communities.

Collaboration among key stakeholders, including the Ascension Foundation, Meharry Medical College, local schools, and community organizations, strengthens the program's implementation and evaluation. This partnership-driven approach reflects best practices in community-based participatory research, emphasizing collaboration as a means to address

systemic inequities (Israel et al., 1998). By involving diverse partners, the program not only broadens its reach but also ensures cultural and contextual relevance, enhancing its impact on participating communities.

The Ascension Foundation's commitment to #GOALS reflects its broader mission to reduce health disparities and promote equity. The program not only inspires young students to consider careers in science and medicine but also lays the groundwork for a more inclusive and innovative healthcare system. By empowering students with knowledge, skills, and mentorship, #GOALS contributes to shaping a future where equity and diversity are at the core of healthcare and scientific advancement.

Background: Existing "Pathway to College" Programs Implemented on a Middle School Level

While many high schools have programs that help students define their career path, this is not necessarily the case for middle school. However, middle school is increasingly recognized as a critical period for interventions aimed at preparing students for postsecondary education. Research shows that early exposure to college-related programs significantly influences students' aspirations, academic preparation, and eventual enrollment in higher education (Roderick et al., 2009; Perna & Swail, 2001). Middle school is being called a pivotal stage for fostering college aspirations and academic readiness. During this period, students begin to develop self-concepts about their academic abilities and career interests (Eccles, 2009). Programs targeting middle school students capitalize on this developmental stage to instill a college-going culture, particularly for those from underrepresented backgrounds. Research demonstrates that early exposure to college-related content positively impacts students' academic engagement and postsecondary aspirations (Gándara & Bial, 2001).

Successful middle school programs often integrate academic preparation, mentoring, and experiential learning. Academic preparation typically includes tutoring, advanced coursework, and skill-building workshops aimed at strengthening foundational competencies in core subjects (Perna & Swail, 2001). Mentoring programs connect students with older peers or professionals who provide guidance and encouragement. Experiential learning, such as campus visits and career exploration activities, helps demystify the college experience and make it more tangible for students (Hossler & Vesper, 1999).

Research indicates that middle school interventions can lead to measurable improvements in college readiness and enrollment. Students who participate in these programs often demonstrate higher academic achievement, greater persistence in high school, and increased likelihood of enrolling in postsecondary education (Hossler & Vesper, 1999). Longitudinal studies suggest that the benefits of early interventions extend into adulthood, with participants more likely to pursue and complete higher education (Swail & Perna, 2002).

There are several examples of middle-school college preparation programs. Programs like AVID[1] (Advancement Via Individual Determination) and GEAR UP[2] (Gaining Early

[1] https://www.avid.org/

[2] https://www.ed.gov/grants-and-programs/grants-special-populations/economically-disadvantaged-students/gaining-early-awareness-and-readiness-for-undergraduate-programs-gear-up

Awareness and Readiness for Undergraduate Programs) have been widely implemented to support college readiness in middle schools. AVID focuses on academic support, organizational skills, and goal setting, with demonstrated effectiveness in improving college enrollment rates among low-income and first-generation students (Schools, 2015; Gaskins, 2014; Willis, 2021; Smith, 2024). GEAR UP combines academic interventions, parental engagement, and partnerships with higher education institutions to build long-term support systems for students (Kim et al., 2024; Villar, 2014). However, these are government-sponsored or supported programs, and most importantly, they do not address careers in STEM.

Moreover, despite their benefits, middle school college pathway programs face challenges related to funding, scalability, and equity. Sustained funding is critical for maintaining program quality and reach, yet many initiatives rely on grants that may not be renewable (Gándara, 2001). Additionally, ensuring that programs are equitably distributed across schools and districts remains a persistent challenge, as disparities in resources and access can limit their impact on underserved populations (Kao & Tienda, 1998).

Therefore, taking into consideration the challenges faced by middle school college prep programs, including limited resources, inconsistent implementation, and systemic inequities, the #GOALS program is a critical initiative that leverages interactive STEM activities, mentorship, and innovative digital tools to inspire underserved students and equip them with the skills and support needed to pursue higher education and careers in healthcare and science. Scaling up the #GOALS program would require a multifaceted approach that addresses infrastructure, funding, partnerships, and evaluation. Expanding the program to reach a larger audience would necessitate increased funding to support additional resources, such as more frequent events, expanded digital platforms, and enhanced staffing, including program coordinators, mentors, and technical experts. Strengthening partnerships with schools, higher education institutions, and community organizations would be essential to ensure widespread implementation and localized relevance. Investment in robust digital infrastructure, such as virtual learning environments and mobile apps, would facilitate scalability while maintaining engagement across diverse student populations. Standardized yet adaptable program modules would allow for consistent delivery while accommodating regional differences.

But most importantly, a comprehensive evaluation framework would be crucial to track the program's effectiveness at scale, ensuring data-driven refinement to maintain quality and impact. Therefore, the Ascension foundation partnered with University of Notre Dame’s Lucy Family Institute for Data & Society to conduct a comprehensive evaluation study to evaluate the program's effectiveness in increasing students' interest in healthcare careers and their engagement in STEM education.

Evaluation Study Objectives

Research consistently shows that healthcare outcomes improve when there is concordance between the racial and cultural backgrounds of patients and caregivers. Despite this, significant barriers prevent diverse representation within healthcare professions. The #GOALS program addresses this gap by engaging students early in their educational paths, using interactive experiences to foster interest in medical sciences. The proposed study seeks to quantify the

long-term effects of these engagement interventions and identify effective practices for scaling and enhancing the program.

Evaluation Study Design

This study evaluates the impact of #GOALS on students' educational and career trajectories, focusing on how participation influences interest in healthcare and STEM fields. The program incorporates several research-backed interventions to maximize its effectiveness, including a gamified approach to data collection. These components are grounded in literature highlighting the importance of early exposure to STEM careers and the role of experiential learning in shaping students' aspirations (Maltese & Tai, 2011). Feedback from participants, parents, and educators is an integral part of the program's iterative design, ensuring continuous refinement to meet the needs of its diverse audience.

In our approach to evaluating the impact of the #GOALS program, we employ a variety of methodological strategies to ensure robust and reliable data collection. First, we will develop and deploy a custom mobile application, equipped with push technology, to maintain ongoing engagement with the students and facilitate real-time data collection. This application will serve as a central tool for both communicating with participants and gathering systematic feedback on their experiences and aspirations.

A longitudinal approach will track a cohort of middle school students over five to six years to measure the program's impact on their academic achievements and career aspirations. This design builds on evidence from long-term educational interventions, which show that sustained engagement is crucial for fostering interest in STEM fields (Estrada et al., 2016). Pre- and post-event surveys, developed in collaboration with the Ascension Foundation, will capture immediate shifts in student attitudes and long-term changes in educational outcomes. These surveys will assess variables such as self-efficacy, academic performance, and interest in STEM and healthcare careers, aligning with validated measures from prior STEM education research (Bandura, 1997; Zimmerman & Cleary, 2006).

Evaluation surveys will be administered periodically to track changes in students' interest in healthcare careers, their academic progress, and other psychosocial variables that could influence their career paths. These surveys will be strategically distributed at the outset, midpoint, and conclusion of the program, and at annual follow-ups to capture longitudinal data. Additionally, we plan to collaborate with schools and educational institutions to access academic records and other relevant performance metrics. This partnership will allow us to track educational outcomes and correlate them with program participation levels, providing a multi-dimensional view of the program's impact.

To enhance engagement and learning, the program incorporates innovative digital tools such as a Roblox-based game for data collection and virtual simulations of healthcare careers. Gamified learning environments like Roblox have been shown to increase student motivation and retention of STEM concepts by making learning interactive and immersive (Hamari et al., 2016; Gee, 2003).

There is a large body of research addressing gamified approach to introducing concepts or collecting data among middle school students. For example, Hong and Masood (2014) examine the impact of gamification on the motivation and engagement of lower secondary

school students. The researchers implemented game-based learning strategies in classroom settings and found that gamification significantly enhanced students' intrinsic motivation and engagement with learning activities. The study highlights the potential of game elements, such as rewards and challenges, in fostering an interactive and enjoyable learning environment for younger students. Rider (2017) explored the effects of incorporating gamification principles into middle and high school science classrooms. The study reported that gamification improved student engagement, participation, and interest in science subjects by incorporating game mechanics such as points, badges, and leaderboards. Rider (2017) emphasized that gamification can make science education more dynamic and appealing, particularly for students who may otherwise struggle with traditional teaching methods.

Dehghanzadeh et al. (2024) provided a systematic literature review on the use of gamification in K-12 education, synthesizing findings from numerous studies. The review identified key gamification elements – such as rewards, competition, and storytelling – that positively influence learning outcomes, motivation, and engagement. It also highlights challenges, including the need for teacher training and the careful design of gamified activities to avoid overemphasis on extrinsic rewards. The study provided a comprehensive overview of how gamification supports educational objectives in diverse K-12 settings, and was used as a foundation for creating the Roblox game that will be developed and updated throughout the study to continuously engage students and maintain their interest in the #GOALS program.

There are other interventions, already available at the schools, which will be tracked for their contribution to a sustained interest in STEM careers. Recurring school-based sessions with guest speakers from healthcare and science fields have been reported to have sustained exposure and mentorship, a critical factor in maintaining interest in STEM careers (Sadler et al., 2010). These and other related interventions will be evaluated immediately after the events, and at specified intervals, to assess their longitudinal effectiveness.

Analytic Techniques

The evaluation employs a step-wedge cluster randomized trial (SW-CRT) design (Barker et al., 2016), which systematically introduces the program to participating schools in a staggered manner over time. In this design, all participants or clusters eventually receive the intervention, but at different times randomly assigned. The time at which each cluster transitions from the control condition to the intervention condition is randomized. For this study, clusters will be defined as individual schools participating in the #GOALS program. We will include schools from various geographic locations that have agreed to participate. This design involves collecting baseline data from all schools prior to any school receiving the intervention. As each semester progresses, a new cluster begins the intervention, allowing continuous data collection from schools at various stages of intervention exposure. Primary outcomes include changes in student interest in healthcare careers and academic performance in science, while secondary outcomes focus on students' satisfaction and career aspirations.

This step-wedge approach offers significant ethical and practical advantages. It ensures all participants eventually receive the potentially beneficial intervention, thereby meeting ethical standards, and accommodates logistical challenges related to resources and program implementation. Additionally, the design allows for the examination of the intervention’s

temporal effects and its adaptability to different community settings, enhancing the robustness and applicability of the study findings.

The study also includes the development of a new dataset that tracks students' progress through the program and beyond. This dataset will capture information on academic performance, participation in STEM activities, and career choices, providing a valuable resource for future research on educational interventions. The data will also include details on student demographics, enabling analysis of how #GOALS impacts different subgroups within underserved populations. By making this dataset publicly available, the program aims to contribute to the broader body of knowledge on STEM education and workforce diversity. Advanced machine learning and statistical methods will be developed to process the collected data, using both descriptive and inferential frameworks to assess the significance and magnitude of the observed effects. This comprehensive methodological approach ensures that the study will provide meaningful, actionable insights into the effectiveness of the #GOALS program in fostering long-term interest in healthcare (or related STEM) careers among underserved middle school students.

Anticipated Outcomes

Anticipated outcomes of this study include comprehensive data on the effectiveness of early career exposure in influencing healthcare career trajectories; insights into the most effective frequencies and types of engagement for maximizing and sustaining student interest in healthcare, and recommendations for enhancing the #GOALS program based on empirical evidence. The Ascension Foundation for Health Equity will gain a clearer understanding of how early exposure to healthcare and STEM careers influences long-term aspirations and achievements. The findings will identify which program components are most effective in sustaining interest in healthcare careers, informing strategies for scaling the initiative to a national level.

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