How to Explore the Role of an Informal Medical Experience on Student Interest in STEM Careers

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Introduction

Field trips are a part of many students' school experiences. Field trips are typically viewed as enjoyable because they provide a chance for students to see something new or different and because they provide an opportunity to be outside of the normal school routine. At the Griffin Museum of Science and Industry (Griffin MSI) we offer several fieldtrip options, including the opportunity to participate in a learning lab—a hands-on museum classroom experience focused on a science topic. In the research study discussed here, we share how we plan to explore the specific effects of attending a medical learning lab on students' STEM career interests and the insights we gained from reflecting on the baseline data. While we have internal and external evaluation reports of the value of learning labs, we do not yet have strong indicators to show the impact of our programs. Understanding our impact is especially important given that Griffin MSI welcomes over 200,000 students every year and about 25% of the U.S. workforce is engaged in a STEM job (National Center for Science and Engineering Statistics, 2023). As a cultural institution, we have the opportunity to engage students, especially those from racial and ethnic identities underrepresented in the STEM workforce, and foster their early interest in STEM careers. In this article, I will describe learning labs at Griffin MSI, share our research questions, explain the importance of our methodology, and explore what the baseline data tells us about our student participants.

MedLab Learning Lab

Learning labs at Griffin MSI are museum-based classroom experiences. Topics include "Colorful Chemistry," where students learn about what happens when you mix chemicals and add heat, and "Crime Lab," where students act as forensic scientists and solve a crime. Each learning lab was created with Next Generation Science Standards in mind. Educators can find how the labs connect to science and engineering practices, cross-cutting concepts, and disciplinary core ideas on our website. Importantly, during each learning lab the facilitator discusses how the content and the experience of the learning lab connect with careers in science, technology, engineering, and mathematics (STEM). For some students, this may be the first time that they are introduced to STEM careers outside of the stereotypical image of a scientist who works by themselves, in a lab coat, holding a beaker, and learn about forensic scientists, x-ray technicians, and engineers.

Learning labs provide a range of unique opportunities for students to engage in hands-on science experiences. One of these learning labs, MedLab, engages students in authentic medical practices like finding a patient's pulse, checking pupillary response, and listening to wheezing. The learning lab is facilitated by a Griffin MSI educator, who engages the students in conversations and activities related to one of three health issues: heart disease, diabetes, or asthma. Griffin MSI staff focused on these topics because of their strong impacts on minoritized communities in the

city of Chicago (e.g. Gillum 1996; Cheng, et al. 2019; Bryant-Stephens 2009). According to the census bureau, nearly 30% of individuals in Chicago are Black or African American and nearly 30% of individuals are Hispanic or Latino (Census July 2023). Therefore, it is additionally important for us to consider the role of racial and ethnic identity as we consider the effects of a lesson that is intended to be connecting students to their community, which may also be inextricable from their racial and ethnic identity. For students who strongly identify with their racial and ethnic identity, MedLab might be especially helpful in increasing their interest in STEM careers.

Figure 1. Students (green scrubs) and a learning lab facilitator (dark blue scrubs) engage with a human simulator during MedLab. Museum of Science and Industry Chicago, J.B. Spector.

Research Questions
There is anecdotal evidence and some literature to suggest that learning labs are related to positive student learning outcomes (Applebaum 2014). However, like most informal STEM learning environments, we don't have the right type of evidence to say that attending a learning lab, or similar experience, *causes* effects on students. To gain that type of evidence, we need to run a controlled experiment. In a study entitled, The MEDLAB Experience - Museum Education in Diversity for Laboratory and Biological Experiences, we did just that.

In the current study we focused on students' interest in STEM careers, specifically health careers, and the relationship between the students' racial and ethnic identity and their career interest. We asked two questions:
1. How does the MedLab experience impact adolescent youth interest in STEM careers?
2. How is that impact related to racial and ethnic identity?

We expected that attending the MedLab experience would increase student interest in STEM careers. We also expected that the effect of the MedLab experience would be moderated by students' strength of their racial and ethnic identity such that those with a strong sense of their

racial and ethnic identity would show more interest in STEM careers than students with a lower sense of their racial and ethnic identity, especially if they were in the MedLab condition.

The Study
To investigate these questions, we conducted a randomized control trial of classrooms of students who came to Griffin MSI for a learning lab. A randomized control trial is the gold standard for research because it means that participants (classrooms of students) were randomly assigned to either the experimental condition (one of the three MedLab learning labs: Asthma, Diabetes, or Heart Disease) or to the control condition (any non-MedLab learning lab). This random assignment reduces any biases a classroom of students may bring based on prior knowledge, interest, or background because none of these factors determined whether the students were in the MedLab or control condition. A simple coin flip determined the condition, not the students or the teacher. Because classes were randomly assigned to condition, we can assume (and use statistics to confirm) that the groups would be similar, so the differences we see in interest in STEM careers or relationships with racial and ethnic identity would be more likely to be *caused* by attending MedLab and less likely to be due to something uniquely different about the students or their teachers.

To encourage participation in our study we sent multiple mailings out through our education newsletter. Educators were incentivized with a free learning lab and a free bus for their students. If the students completed all surveys, teachers also received a tablet valued around $200. Any interested teachers were encouraged to contact the Research and Evaluation department at Griffin MSI. Before enrolling in the study, teachers were required to attend an information session explaining the research project and their role in administering the pre- and delayed post-surveys. Teachers who completed the information session were put in contact with staff at our call center, who flipped a coin to determine the condition for the teacher's classroom. Once classrooms were randomly assigned to a condition and signed up for a learning lab within their condition, a member of the Research and Evaluation department mailed the teacher pre-surveys for the students to take two weeks before their visit. You can see the full survey timeline in Table 1.

Coin flipped and class assigned condition	Pre-Survey	Attend Griffin MSI for Learning Lab	Post-Survey	Delayed Post-Survey
	2-weeks before visit		Immediately after lab	2-weeks after visit

Table 1. Timeline of MedLab Study.

On the day of their learning lab, students arrived and participated in their assigned condition. The facilitators of the lab delivered the experience in the same way they would have if the classroom was not part of a research study. At the end of the lab, students were asked to take a post-survey, which consisted of the same questions as the pre-survey. Teachers were then asked to administer a delayed post-survey 2-weeks after their visit to assess any persistent effects of the lab experience.

Figure 2. Students in non-MedLab learning lab. ©2014 J.B. Spector / Museum of Science and Industry Chicago

Who Participated

The study began in the spring of 2022 and continued during the 2022-2023 school year. By the end of the study 46 teachers brought 1,260 students to participate in the MedLab Study. Twenty-six teachers (810 students) were assigned to the MedLab condition, and 20 teachers (450 students) were assigned to the control condition. The reader can find demographic information about the participants in each condition in Table 2. (Note: The demographic information listed is only for students who participated in both pre- and post-surveys. These are the students whose data will be analyzed to understand the effect of MedLab.) Overall, the average age of students was 13 years of age for both conditions, about half of our sample identified as girls, and students tended to identify as Hispanic/Latino or Black/African American. While there are some categories for which the MedLab condition is higher, (e.g. percentage of White students), and some categories for which the Control condition is higher (e.g. percentage of female students), there were no statistically significant differences between groups for any demographic item. The similarity between the conditions sets us up well for comparing the effects of attending MedLab on students' career interests.

Baseline characteristic	Immediate follow-up survey sample ($n = 1,112$)	
	MedLab ($n = 711$)	Control ($n = 401$)
Demographic information		
Female	47.6%	55.6%
Neither female nor male	6.2%	5.1%
White	22.6%	13.8%
Black/African American	24.9%	25.6%

Baseline characteristic	Immediate follow-up survey sample (n = 1,112)	
	MedLab (n = 711)	Control (n = 401)
Hispanic/Latino	47.5%	43.5%
Asian	6.1%	9.8%
American Indian/Alaskan Native	2.4%	1.8%
Middle Eastern/North African	7.6%	3.6%
Hawaiian/Pacific Islander	0.4%	0.5%
Parent has BA or higher	38.3%	40.0%
Age	13.21	13.24

Table 2. Demographic characteristics of participants in the MedLab and Control conditions.

Baseline data

Our first question was "How does the MedLab experience impact adolescent youth awareness of and interest in STEM careers?" To answer this question, we asked students on all three surveys to list "the top 2 jobs [they] are interested in pursuing as a career." We then asked them to share if they thought each career was a STEM career. Students could respond "yes", it was a STEM career, "no" it was not a STEM career, or "not sure" if they didn't know if it was a STEM career or not. Because students do not always know what a STEM career is and what it isn't, researchers also coded the careers as STEM or not STEM. Within STEM careers, researchers also separately identified the subset of careers that were health careers, since MedLab focused on health careers.

When we looked at the pre-survey data, we found very little difference between MedLab and Control groups in their STEM and health career interest. (See Figure 3.) The STEM careers students identified they were interested in, even before taking a learning lab, included: scientist, engineer, nursing midwife, electrician, welding [sic], and doctor. With more than half of students in each condition already expressing STEM career interest, it will be interesting to see if MedLab will have an impact over and above students' initial interest levels.
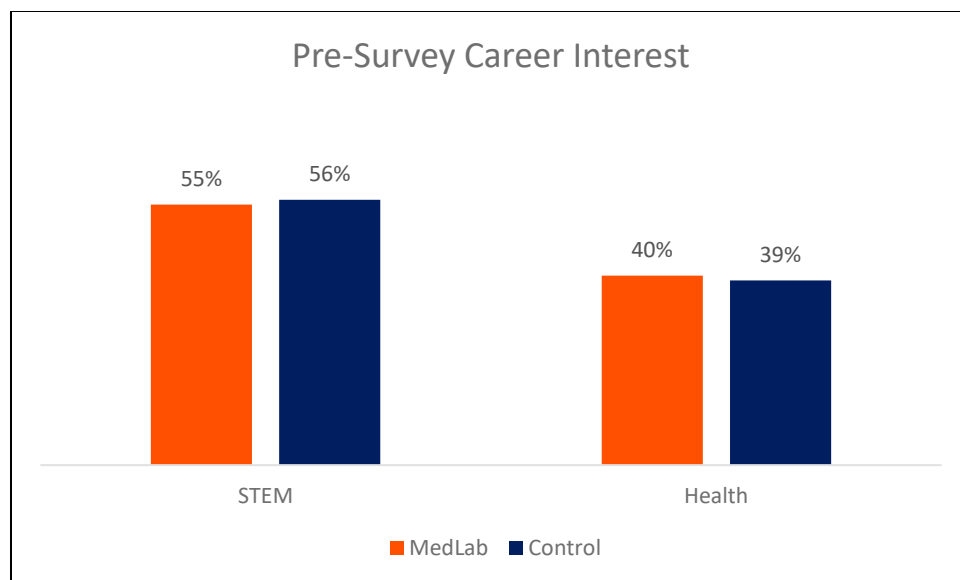
Figure 3. STEM and health career interest at pre-survey for Control and MedLab conditions. Note: Careers in health are a subset of STEM jobs.
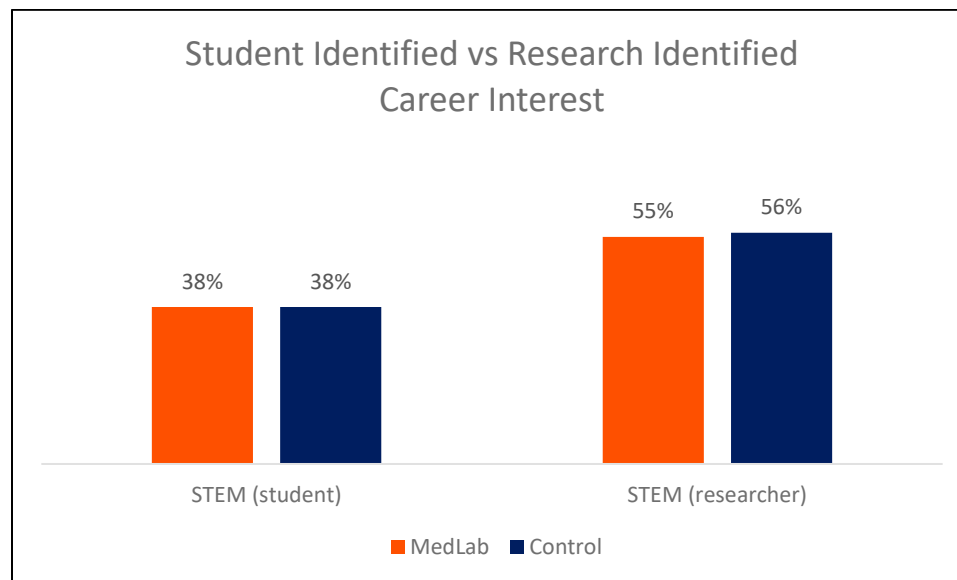
Our second question was "How is that impact related to racial and ethnic identity?" We used two scales to understand students' relationships with their racial and ethnic identity: the Ethnic Identity Scale–Brief (EIS) (Umaña-Taylor et al. 2004; Douglass & Umaña-Taylor 2015) and the Multidimensional Inventory of Black Identity (MIBI) (Sellers et al. 1997). The EIS is designed to understand ethnic identity formation and includes items such as "I know what my ethnicity means to me" and "I wish I were of a different ethnicity." Students were asked to rate these items from 1 ("Does not describe me at all") to 4 ("Describes me very well"). The MIBI is another scale used to understand racial and ethnic identity and includes items like "Society views people in my ethnicity as an asset" and "In general, others respect people in my ethnic group." Students were asked to rate these items from 1-Strongly disagree to 7-Strongly agree.

At pre-survey, students in the MedLab and Control conditions fell roughly in the middle of both the EIS (MedLab = 2.29, Control = 2.26) and MIBI scales (MedLab = 4.32, Control = 4.29), suggesting overall neutral feelings related to their racial and ethnic identity. Further analyses will determine if students' identification with their racial and ethnic identity will influence the effects MedLab has on STEM career interest.

Follow-up Research Questions
While we await the final results of the current study, an additional question emerges from the data: What is the effect of attending MedLab on students' ability to identify STEM careers, including health careers? As discussed, students identified their careers as STEM, not STEM, or they noted if they were unsure. At pre-survey, we noticed a large difference between careers researchers identified as STEM and those that students identified as STEM. (See Figure 4.) There is nearly a 20-percentage-point discrepancy between what students identified as a STEM

career and what researchers identified as a STEM career. Can attending MedLab, or perhaps any learning lab, affect students' identification of STEM careers? We will be investigating this question in our final analyses.

Conclusions and Next Steps

Observing baseline data from a randomized control trial has helped us better understand the career interest tendencies of middle-school-aged youth who visited a cultural institution for a museum-based classroom experience. Baseline data showed that students already came to learning labs with a high level of STEM interest, though not all students are able to recognize what constitutes a STEM career. They also tend to feel neutral regarding their racial and ethnic identity. However, the EIS and MIBI values we report here only tell us on average how students feel, not about variation along the scales.

Given our unexpected STEM career identification findings, our future work will look for differences in career interest and STEM career identification as a result of participating in a MedLab learning lab. We will be particularly interested to know how variations in racial and ethnic identity affect the relationship between attending MedLab and students' STEM career interest. Importantly, forthcoming analyses will include pre-survey, post-survey, and delayed-post-survey data, which will allow us to look not only for an effect of MedLab, but also for the persistence of any effects.

Takeaways

There are two important takeaways from this article that I think apply, regardless of where you live in the museum world: 1) the way you collect data is important and 2) be open to new findings. I think we are all data collectors. Data doesn't just come through online surveys or formal interviews, the casual conversations we have on the floor of our museums or with our stakeholders is data. One of the lessons from a study design like the randomized control trial is that it focuses us on *how* we collect the data. It is not always possible to randomize who we

speak to about career interests or about museums, but we can be mindful of who we are talking to. Did I only talk to our members or people who love coming to my museum? Did I talk to people from a range of ages, genders, and racial and ethnic identities? Did I talk to people who don't typically come to this event? How can I reduce the bias in the questions I am asking and in the answers I am receiving?

Once you collect your data, in whatever form it might take, be open to new findings. It's easy to confirm what you already expect when you keep hearing that you're doing a great job or that the new exhibit was well-received but listen for what else people might be saying or other suggestions you hear. In MedLab, we noticed that there was a big difference at pre-survey between how students and how researchers identified the careers students listed. As we move forward with our analyses, we will take seriously a new question about students' abilities to identify STEM careers before and after attending MedLab. If you are interested in future publications on the MedLab work we planned for and the work we uncovered, you can contact Griffin MSI's Research and Evaluation department at studyinfo@msichicago.org to be added to our notification list.

What other questions could you take seriously?

Acknowledgement

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