Work-in-Progress: Partnerships to Create Opportunity through Informal Learning

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Abstract
While many Science, Technology, Engineering, and Math (STEM) programs exist, these are not always easily accessible due to many factors including cost and lack of communication; therefore, greater access to these programs is needed to create and foster existing interest that could lead to STEM careers. Additionally, it has been shown that student's interest in STEM begins decreasing in middle school, thus hindering the pathway to a STEM career. Through this program, we aim to increase access to STEM fields by exposing elementary and middle school students from low-income and underrepresented (UR) communities to STEM career pathways through hands-on activities and continued mentorship. The activities will be offered in collaboration with community partners (e.g., YMCA, Big Brothers Big Sisters) to facilitate students' engagement in STEM beyond the classroom. By offering this program, we aim to (1) inspire continued interest in STEM and (2) strengthen STEM interest through use of a societally relevant problem (i.e. grand challenge) as a theme for our activities. This year, we began establishing formal partnerships with local K-12 organizations, including those that engage students in their own communities. We involved sophomore undergraduates in developing activities; offered an on-campus activity for a community organization; and with partner organizations, worked through the logistics of offering programs at their facilities and scheduled upcoming visits. All activities are created and piloted before being offered and are connected to the Next Generation Science Standards, so the programs are grade appropriate and reinforce concepts presented at school. Each session is targeted to be one hour which includes introduction to the lessons, related hands-on activities, and connection of the lesson/activity to STEM careers through discussing disciplines and majors that provide training to conduct work relevant to the activity. After we receive institutional review board approval, we will use modified versions of published and validated surveys to collect data to answer these research questions: (1) Does participation in the program increase student's interest in STEM? and (2) Does participation in the program increase a student's STEM career aspirations?

Introduction

While many Science, Technology, Engineering, and Math (STEM) programs exist, these are not always easily accessible due to many factors including cost and lack of communication; therefore, greater access to these programs is needed to create and foster existing interest that could lead to STEM careers[1]. Additionally, it has been shown that student's interest in STEM begins decreasing in middle school thus hindering the pathway to a STEM career[2]. To address this need, we established an outreach program that engages the local community organizations to increase access to STEM fields by exposing elementary and middle school students from low-income and underrepresented (UR) communities to STEM career pathways through hands-on activities and continued mentorship. The program is evidence-based and incorporates best practices for STEM diversity and inclusion: cultivating partnerships and collaborations,

providing authentic STEM engagement, and developing and retaining student interest through effective mentorship[3]. The program will provide equitable access to STEM training through hands-on activities, expose UR youth to STEM career pathways, and introduce mentors to guide learning.

To accomplish this, we weave a socially relevant topic, cancer, which also has well-established disparities amongst UR populations, into our STEM activities to create a connection between everyday life and STEM content[4]. Then, hands-on activities are used to engage students and spark continued interest in STEM to increase the likelihood of student's pursuing advanced math and science classes[5] which support college preparation. Finally, activities offered in an informal setting support student's STEM career plans[1]; therefore, we anticipate the activities will inspire student's interest in pursuing STEM careers.

By offering this program, we aim to (1) inspire continued interest in STEM and (2) strengthen STEM interest through use of a societally relevant problem (i.e. cancer) as a theme for our activities. Herein, we describe our process of establishing partnerships, developing material, considering challenges with logistics or in offering material, and formulating next steps.

Program development

The education team within the Cancer Center at Illinois (CCIL) developed formal collaborations with organizations who serve the local community, such as YMCA and Big Brothers Big Sisters. Numerous meetings and site visits were held to better understand the programs and their needs. Specific items such as timing of the programs, number and age of potential participants, space and facility needs for the programming, necessity of background checks to participate at their facilities, and other items were addressed. From discussions with partner organizations, it was determined what programming would best benefit the organization's needs. For the Stephens Family YMCA (Champaign, IL), a one hour program that offered hands-on STEM activities[6, 7] to elementary and middle school students participating in Y on the Fly (a YMCA program that is located and offered in underserved communities and not at the central YMCA facility) was planned and offered twice a month, and for Big Brothers Big Sisters of Central Illinois, an on-campus activity day (about three hours) was offered once per academic semester in which the Littles attended with their Bigs.

In addition to several activities the team already developed, we engaged STEM undergraduate students to develop, pilot, and refine lesson plans and activities with the goal of having a library of ready to go material. With internal funding, we were able to hire three undergraduate students to work two to three hours per week to support the delivery of the program; these students were trained[8, 9] by CCIL staff (including best practices of outreach, working with diverse audiences, and communicating to lay audiences). The student workers introduce the module, guide hands-on activities, and finish the session by discussing disciplines and majors that provide training to conduct cancer focused research relevant to the activity. While the student workers will be the main on-site mentors (due to background check requirements), we also plan to engage the Cancer Center at Illinois Student Organization (CCIL-SO), a registered student organization, as a source of additional mentors for future on-campus events.

Programmatic challenges

Identifying and sustaining partnerships: A significant amount of time was devoted to identifying community and school-based programs with which we could partner. In some instances, we encountered difficulty in making and sustaining initial contacts with community groups due to leadership changes, staffing concerns, and lingering impacts of the pandemic in the partner groups. Some groups, especially those in more rural locations, had little information on their websites and little to no social media presence; this made it challenging to find contact information and learn about their programs.

Overlap with existing programs: The University of Illinois Urbana-Champaign has a strong commitment to community engagement and outreach with numerous units and registered student organizations having long standing outreach programming. Unfortunately, there is no centralized list or contact person who is aware of all the campus outreach activities. Therefore, this required an investigation of multiple websites and discussions with units to learn of existing programming and partnerships in order to prevent overlap and duplication of programming.

Informal setting (non-classroom): Informal STEM programming has numerous benefits to the participants[10], but also comes with several obstacles that will be different than outreach efforts in a school-based setting. Many afterschool programs are offered to a wide age range, which makes it challenging to develop age- and ability-appropriate lessons. The Y on the Fly program for example, serves students in kindergarten through fifth grade. Although many students attend the program regularly for the entire school year, attendance can vary, and students may exit or join the program throughout the academic year. This may affect data collection and attempts to understand the impacts of our programming. Because we are one component of an existing program at YMCA, the logistics of handling parental consent, student assent, and pre-program and post-program surveys for our research are more complex since registration to the program is handled by the community partner. For programs we have hosted on our campus, these items were accomplished in the online registration process. In the afterschool program, we rely heavily on the partnering staff to distribute these items at the beginning of the program since we do not have direct contact with the participant's parents/guardians.

Protection of minors: Protection of minors is of utmost importance. The background check process for volunteers varies by organization and school system; some require checks for all volunteers that enter their facility while others have different requirements if teacher/other background checked individual is present. The lead time to complete these checks and their expense can become prohibitive when trying to integrate large numbers of university student mentors into the outreach programming. Additionally, if we do secure a background check for an undergraduate student to participate, we ask they commit to at least one semester of engagement.

Sample Activities

We use a variety of activities; some are widely available online, and others are developed by our team and students. One example is summarized here, and a link to the example's full lesson plan (including step-by-step instructions, connection to Next Generation Science Standards, material list, and facility considerations) and additional lesson plans for other activities (continuously updated) is available here: https://go.illinois.edu/CCILoutreach.

Strawberry DNA: Students will learn about DNA: what it is, why it provides valuable information, how genetic factors influence cancer risk, and how genetic testing can guide targeted therapy. Students will then perform a hands-on activity to extract DNA from strawberries, and following this, the mentors will lead a discussion on disciplines/majors that provide training to support this type of work. *Cancer research connection*: Genetic testing to identify mutations associated with cancer development and guide targeted cancer therapy *Some relevant majors that work in this area*: BME, ChBE, MSE, MCB, CHEM

Future plans

During Spring 2023, we piloted and refined STEM lessons and activities and gained experience working with community partners to better understand their needs and processes. Insights gained during this time support program improvement and preparation for data collection to begin in Summer/Fall 2023. Understanding each partner's participant registration process and ongoing participation rates will support us in developing our protocol to collect the consent, assent, and pre-survey responses, as a means to maximize participation in the study. Once institutional review board approval is received, we will begin research participant recruitment (targeting middle school and above) during our partner's registration process for the 2023-2024 afterschool program and begin data collection.

We will use a modified version of the (1) STEM Semantics Survey[11] to identify student's interest level pre- and post-program and (2) STEM Career Interest Survey (STEM-CIS)[12] to ascertain any changes in career aspiration pre- and post-program. The mentors will also provide qualitative feedback on changes in student's interest during the program. Together, the quantitative and qualitative data will support our understanding of the program impact.

With experience and program refinement, we will broaden our impact by expanding our outreach programming to additional community partners and/or schools and recruit and train cohorts of university student mentors to scale up our established model.

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References

[1] K. P. Dabney, R. H. Tai, J. T. Almarode, J. L. Miller-Friedmann, G. Sonnert, P. M. Sadler, and Z. Hazari, "Out-of-school time science activities and their association with career interest in STEM," *International Journal of Science Education, Part B,* vol. 2, no. 1, pp. 63-79, 2012/03/01 2012, doi: 10.1080/21548455.2011.629455.

[2] R. George, "A cross-domain analysis of change in students' attitudes toward science and attitudes about the utility of science," *International Journal of Science Education,* vol. 28, no. 6, pp. 571-589, 2006/05/12 2006, doi: 10.1080/09500690500338755.

[3] (September 2021). *Best practices for diversity and inclusion in STEM education and research: a guide by and for federal agencies*. [Online] Available: https://www.whitehouse.gov/ostp/nstc/reports/

[4] J. M. Valla and W. M. Williams, "Increasing achievement and higher-education representation of under-represented groups in science, technology, engineering, and mathematics fields: a review of current K-12 intervention programs," *Journal of Women and Minorities in Science and Engineering,* vol. 18, no. 1, pp. 21-53, 2012, doi: 10.1615/JWomenMinorScienEng.2012002908.

[5] N. Dejarnette, "America's children: providing early exposure to STEM (Science, Technology, Engineering, & Math) initiatives," *Education,* vol. 133, pp. 77-84, 09/01 2012.

[6] A. A. Carin and J. L. Bass, *Teaching Science as Inquiry*, 9th ed. Pearson, 2001.

[7] D. Satterthwait, "Why are 'hands-on' science activities so effective for student learning?," (in English), *Teaching Science,* vol. 56, no. 2, pp. 7-10, Jun 2010 2010.

[8] R. L. Stelter, J. B. Kupersmidt, and K. N. Stump, "Establishing effective STEM mentoring relationships through mentor training," *Annals of the New York Academy of Sciences,* vol. 1483, no. 1, pp. 224-243, 2021/01/01 2021, doi: https://doi.org/10.1111/nyas.14470.

[9] K. Komosa-Hawkins, "Best practices in school-based mentoring programs for adolescents," *Child & Youth Services,* vol. 31, no. 3-4, pp. 121-137, 2010/11/01 2010, doi: 10.1080/0145935X.2009.524477.

[10] P. J. Allen, R. Chang, B. K. Gorrall, L. Waggenspack, E. Fukuda, T. D. Little, and G. G. Noam, "From quality to outcomes: a national study of afterschool STEM programming," *International Journal of STEM Education,* vol. 6, no. 1, p. 37, 2019/11/12 2019, doi: 10.1186/s40594-019-0191-2.

[11] R. Christensen, G. Knezek, and T. Tyler-Wood, "Student perceptions of Science, Technology, Engineering and Mathematics (STEM) content and careers," *Computers in Human Behavior,* vol. 34, pp. 173-186, 2014/05/01/ 2014, doi: https://doi.org/10.1016/j.chb.2014.01.046.

[12] M. W. Kier, M. R. Blanchard, J. W. Osborne, and J. L. Albert, "The development of the STEM career interest survey (STEM-CIS)," *Research in Science Education,* vol. 44, no. 3, pp. 461-481, 2014/06/01 2014, doi: 10.1007/s11165-013-9389-3.