

Broader Impacts: Building on Areas of Shared Interest for Effective STEM Engagement among Youth

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INTRODUCTION: While musculoskeletal research remains central to the efforts of the Orthopedic Research Society, funding sources evaluate broader impacts for proposals, such as the NSF GRFP and the NSF CAREER Award. Musculoskeletal health is significantly impacted by the Social Determinants of Health (SDOH), which broadly include 1) economic stability, 2) education access and quality, 3) health care access and quality, 4) neighborhood environment, and 5) social and community context. In turn, SDOH are heavily influenced by educational attainment. The capacity to engage youth in STEM learning outside of school is an important contributor to future STEM educational attainment and the formation of STEM identity. We sought to generate STEM interest through sports due to their inherent diversity, accessibility, and alignment with topics in orthopaedics. Taken together, we have potential to achieve a world without musculoskeletal limitations, not only through our fundamental research, but also through our educational outreach.

METHODS: We developed a basketball-centered STEM outreach program called, “Science of the Slam” where middle school students use the scientific method to collect vertical jump height data and predict which contestant will win a Slam Dunk contest. Importantly, we developed this program based on our own interest in basketball and sport performance measurement (two out of three authors were college basketball players and remain active in the basketball community). The goal of this program is to engage youth athletes in STEM learning within an Area of Shared Interest, wherein we could meet basketball-interested youth and create a bridge between STEM and basketball. We delivered this program at 5 middle schools in Racine, WI and 4 middle schools on the south side of Chicago during a series of school assemblies in the gymnasium. Over the course of 12 days, we engaged over 3,000+ middle school students in STEM learning across our 9 partner schools. For continuous program improvement and growth, we evaluated the efficacy of the Science of the Slam using short pre- and post-surveys. Students reported their habitual after-school activity participation; occupational interests; and their interests in STEM, sports, biomechanics, and sports science. School administrators were provided with hard copies of pre-intervention surveys to be distributed in the classroom prior to the event. Hard copies of post-intervention surveys were left with the schools following each event and were collected upon school-wide survey completion. During program evaluation, we reviewed the data and realized this may be of interest to the STEM education and orthopedic research communities. As such, we obtained IRB exemption from the Human Subjects Review Committee at Union College as per 45 CFR 46.104(d)(2) in order to share our findings with the broader academic communities. The specific aims that we report on are: 1) What activities and career aspirations do middle school students generally pursue and how is this related to their current STEM interests? 2) What is the impact of our short-term sports biomechanics approach on students’ STEM interest? 3) How does the impact differ across students with various pre-existing interests? We tested for program effects by conducting paired t-tests (for composite scores) and Wilcoxon signed ranks tests (for single-item measures) on pre and post survey responses. Additionally, we ran mixed ANOVA’s to test for moderation of program effects by students’ current participation in STEM activities and students’ current participation in basketball.

RESULTS: A total of 1293 students ranging from 2nd to 8th grade (Mean age = 12.6 years, SD = 1.01 years) completed at least 1 survey. 44% of the sample completed both surveys (N = 1032 pre-survey completion and N = 823 post-survey completion). Among students who reported career aspirations (N= 1012), only 17.2% aspired to explore a STEM+M career, whereas 23.1% aspired to have a career in sports. Students reported current participation in Performing Arts (54.4%), Team Sports (53.4%), Video Gaming (38.8%), Individual Sports (33.3%), STEM Activities (12.0%), and other activities (8.8%). Notably, basketball was one of the most prevalent Team Sport activities with 31.9% of the sample participating, which closely followed video gaming in popularity. Students’ participation in STEM activities did not significantly moderate any program effects ($p \geq .05$); however, some program effects on STEM interest were amplified for students who play basketball. Across all students, the program significantly increased students’ familiarity with sports science ($z = -6.94, p \leq .001$), value of sports science [$t(504) = 9.23, p \leq .001, d = 0.41$], and interest in learning more about sports science ($z = -2.85, p = .004$). The program led to significant increases in interest in STEM [$F(1, 494) = 26.58, p \leq .001$], how much students value STEM [$F(1, 506) = 6.77, p = .01$], and students’ self-efficacy in STEM [$F(1, 494) = 4.91, p = .027$]. Enhanced interest in STEM was qualified by basketball participation [$F(1, 494) = 15.54, p \leq .001$], meaning only basketball players showed a significant increase in STEM interest (Figure 1).

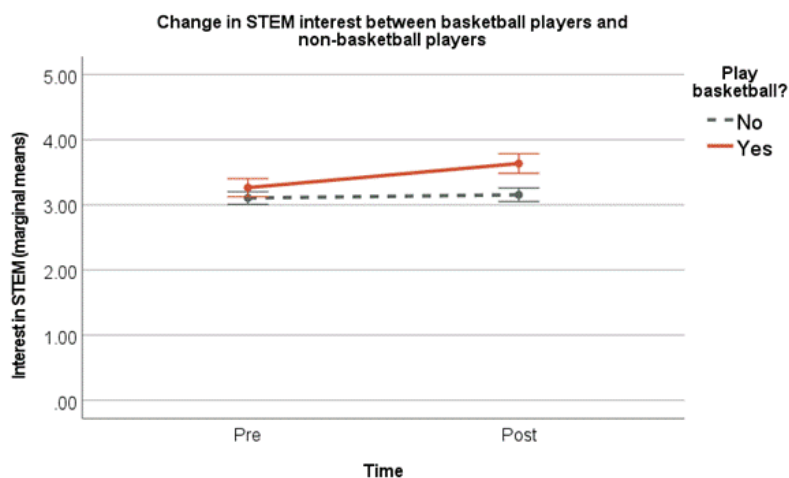


Figure 1. The Science of the Slam program significantly enhanced STEM interest for students who currently play basketball ($p \leq 0.001$). Error bars represent 95% confidence interval.

DISCUSSION: These findings demonstrate that the direct applicability of musculoskeletal research to youth activities, such as basketball, provide a unique opportunity for researchers to engage youth in STEM learning in informal settings. The relative popularity of out-of-school activities such as team sports (53.4%) and performing arts (54.4%) in contrast to STEM activities (12.0%) highlights the potential for ORS members to create innovative, non-STEM centered programs, to engage new populations of youth within STEM, based on shared Areas of Shared Interest. The efficacy of the Science of the Slam program in increasing STEM interest among youth basketball players provides evidence that this Areas of Shared Interest approach to outreach, where researchers start with their own non-STEM interests and build a STEM program around this activity, has significant potential to broaden STEM engagement.

SIGNIFICANCE/CLINICAL RELEVANCE: The Orthopaedic Research Society seeks to achieve a world without musculoskeletal limitations. Our fundamental musculoskeletal research is crucial to achieve this impact; however, ORS members have the potential to address significant issues in musculoskeletal health generated by Social Determinants of Health by engaging new populations of youth in STEM.

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