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# Work in Progress: A two-way learning street: Near-peer college students enhance high school after-school STEM club opportunities

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As the oldest of four in a single-parent household near Dayton, Ohio, my upbringing instilled a deep sense of responsibility and resilience. Growing up, I developed a passion for math and science, which shaped my academic pursuits and guided my career path. I earned my Bachelor's and Master's degrees in Mechanical Engineering from the University of Dayton, where I honed my analytical and problem-solving skills. I then worked for five years for General Motors, Delco Marine Division. Throughout my educational journey, I have always sought to combine my technical expertise with a desire to give back to the community. My professional experience began at General Motors, where I worked throughout high school and college. This experience fueled my passion for engineering, but my subsequent transition to teaching truly ignited my spirit. I began teaching at the University of Dayton, moved to Shawnee University, and ultimately found my home at Marshall University. I work in the College of Engineering and Computer Science at Marshall. My mission is to inspire and educate the next generation of innovators. Education is about imparting knowledge, fostering critical thinking, and nurturing creativity. I have been working in student development and success for over thirty years. Outside of teaching, I have held advanced study seminars and tutored, mentored, and encouraged STEM students of all levels. Beyond my academic and professional pursuits, I am a passionate educator and a lifelong learner. I strive to stay updated with the latest advancements in engineering and education methodologies to provide my students with the best possible learning experience. My commitment to education extends beyond the classroom; I am also a devoted husband, father, and friend, and I believe in balancing my personal and professional life.

# Work in Progress: A two-way learning street: Near-peer college students enhance high school after-school STEM club opportunities.


**Abstract**

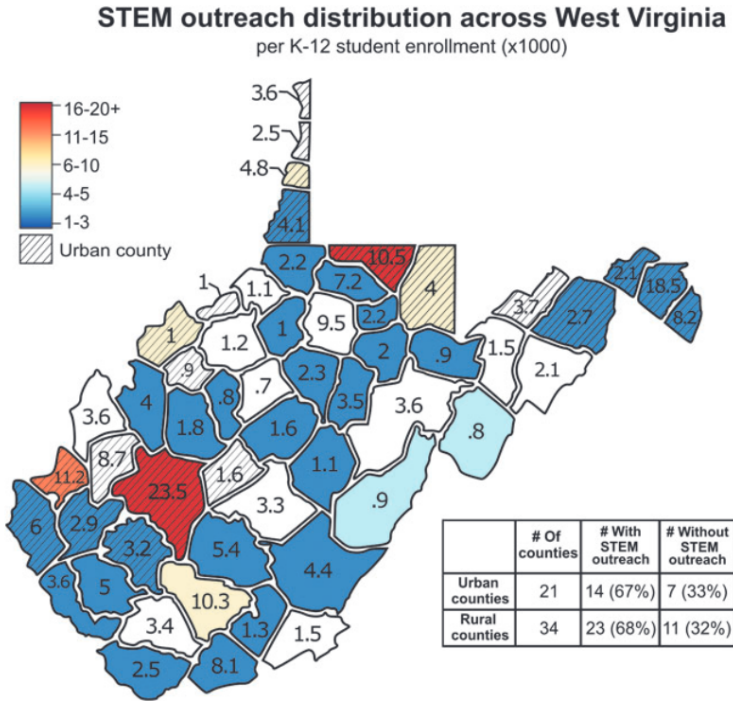
This work-in-progress paper presents a novel way of teaching college and high school students by pairing groups of high school and college to help the high school students create a year-long community-based research project (CBRP)as a requirement for the Health Science Technology Academy (HSTA) in two high schools in West Virginia. The college students assist, teach, and guide the high school groups in organizing their CBRPs. Both peers and students learn the scientific method, survey and experimental design, data collection and cleaning, statistical analysis tools, presentation skills, and team building skills.

This paper will introduce the HSTA program and the importance of CBRPs to its weekly structure, the methodology used in training the near-peers and students, and some preliminary results of this process in a classroom.

We anticipate that our high school students will perform better than those teams who do not have this opportunity and that our near peers will have a more profound understanding of CBRPs, statistical analysis, and experimental design.


## Introduction: The Problem of Rural STEM Education

The United States is experiencing a wave of programs to advance STEM education to satisfy the ongoing demand for STEM researchers and professionals.[1] Yet, in rural communities, limited budgets, restricted opportunities for field trips, laboratory work, and traveling to museums, as




| | # Of counties | # With STEM outreach | # Without STEM outreach | Average # STEM initiatives |
|---|---|---|---|---|
| Urban counties | 21 | 14 (67%) | 7 (33%) | 7.1 |
| Rural counties | 34 | 23 (68%) | 11 (32%) | 2.2 |

**FIG. 1.** STEM outreach across West Virginia. Map displays the distribution of STEM outreach initiatives (summer camps, science centers, STEM programs, extracurricular clubs, and university-affiliated programs) across counties in West Virginia. The number of K-12 students per county for the 2020–2021 academic year is represented by the value within the county × 1,000 (data from the West Virginia Department of Education). *Cooler colors* indicate fewer outreach initiatives, *warmer colors* indicate more outreach initiatives, and *no color* indicates no outreach initiatives. *Cross hatching* indicates urban counties (data from the Economic Research Service, U.S. Department of Agriculture). Table summarizes the distribution of outreach across rural versus urban counties.

well as the distances between rural schools and these resources, challenge schools in providing STEM education. [2]

In West Virginia, a predominately rural state (34 of 55 counties are rural), more STEM outreach efforts are concentrated in urban counties, as shown in Figure 1 and Table 1 from Coltogirone and Kuhn et al.[1]

Here, we see that STEM outreach is poor in rural areas and that average STEM initiatives in urban areas of the state are about 3 times that of rural counties. Many of the rural counties have less than two STEM initiatives.

In addition, rural students are 10 times more likely to prefer working in rural settings[3], which creates a win-win situation in training rural students in STEM fields and research.

**HSTA is an Answer to Rural STEM Education**

The Health Science and Technology Academy (HSTA) has been a part of the STEM pipeline in West Virginia for 30 years. HSTA aims to increase college attendance of rural, first-generation, and financially disadvantaged youth. The students engage in rigorous academic programs throughout the school year, culminating in regional science symposiums that showcase student-led research, mostly community-based research projects. (Chester, McKendall, & McKendall, 2020)

The year-long after-school program allows each HSTA student to investigate many community problems deeply. Examples of research topics include "How does screen time affect sleep," "Is there a link between the daily amounts of sleep and GPA," and "Does STEM interventions lead to a difference in how elementary students view STEM?"

In performing this research, students learn skills not taught in a typical high school curriculum. Some of the advanced subjects taught in an HSTA after-school club meeting are:

- CITI training (Belmont Report) in Human Experimentation
- Community-Based Research Projects
- Technical Written and Oral Communication skills
- Advanced Word, PowerPoint, and Excel skills
- How to deal with messy statistical data
- Dealing with huge datasets
- Parsing a dataset to answer a particular statistical question
- Using statistical analysis tools (t-test, ANOVA, Chi-square, Correlation, Linear Regression)
- Graphing techniques that match the accompanying statistical test

Marshall University, with the help of Drs. Feon Smith and Mary Beth Reynolds headed a quality initiative project that sought to place near-peer college students in high school HSTA clubs to help facilitate learning, provide mentorship, and encourage students as role models of the college experience and success.

Since the HSTA students started as first-year students, Marshall University could assist student learning by introducing a near-peer system. We would like to know whether this method would improve the HSTA club's evaluations of their final community-based research projects (CBRPs) and the near-peer skills and knowledge in teaching and communicating with themselves and the high school mentees.

**Neer-Peer Mentoring**

Peer-assisted teaching involves students teaching other students. It is "people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by doing." [4] Near-peer mentoring is when a more advanced student, i.e., a college student, mentors high school students and is often supported by a seasoned teacher. HSTA, in conjunction with Marshall University, uses near-peers (NPs) to help the primary HSTA teacher teach and facilitate weekly HSTA club meetings.

**Methodology**

We began with six near-peer STEM college students who preferably had experience as previous HSTA high school students. We felt that the students would be both role models and mentors for getting through the HSTA curriculum so that they could see themselves as successful college students.

These near-peers (NPs) trained once weekly with the near-peer leader, a seasoned HSTA teacher. The primary teacher trained the NPs, and the lessons with the high school students were either taught or facilitated by the primary HSTA teacher during the weekly group meetings in the group's respective high schools. Each HSTA group met at least for 24 hours in the fall and spring semesters of the school year.

The students completed hands-on experiments and activities with the primary teacher's and NPs's help, listened and talked to community leaders and educators, and completed their CBRPs. The CBRPs were done either individually or in groups of mostly no more than three students each. Most of the two-semester work was in the completion of the CBRP.

Community judges grade each CBRP with either a regional or local symposium. This score is the basis of the quantitative measurements used in this paper.

We will take the scores from six schools: three with NPs and three without. An ANOVA analysis will determine whether the means of each school's test scores differ. Before and after scores with NPs and no NPs will be examined with paired t-tests to identify possible differences.

We will also collect qualitative data from the students, teachers, and NPs to see what students think of the NPs in this process and what lessons the NPs have learned.

**Preliminary Results and Discussion**

We have CBRP score results from two schools in the Cabell, Lincoln, and Boone HSTA region for two schools, where School A used NPs and School B did not. School A (n=18) has a mean score of 23(1.8), and School B (n=6) has a mean score of 21(1.1). An F-test determined that both sets had equal variances (p = .0653). An equal variance t-test was performed, with p = 0.003. There is a difference between the NP class's versus the non-NP class score.

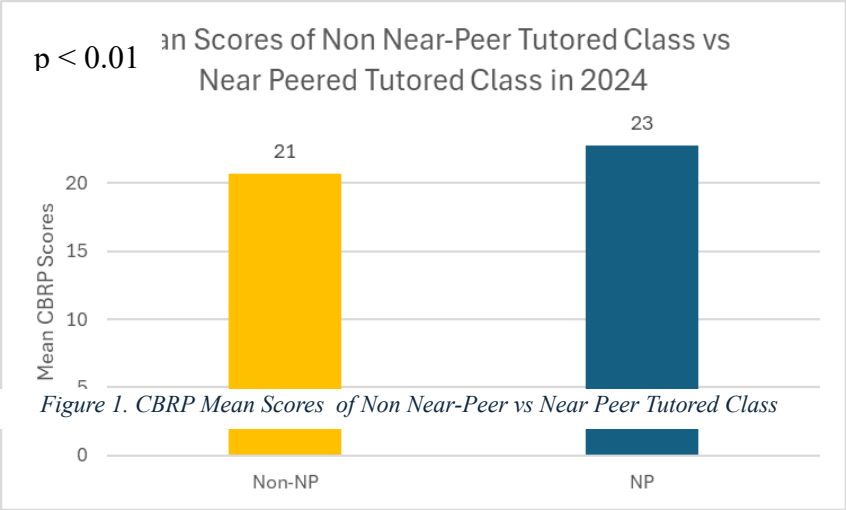



*Figure 1. CBRP Mean Scores of Non Near-Peer vs Near Peer Tutored Class*

An NP gave qualitative comments:

> *"Being part of HSTA allowed me to witness the growth of the students firsthand, and it was incredibly fulfilling. I'd genuinely love the opportunity to continue for another year before I graduate.*
>
> *We taught them various statistical concepts and about college as their next step. I learned to dedicate extra time outside meetings to understand the material, which enhanced my understanding and teaching skills."*

To continue this research, we will collect data from other schools and expand our NPs to mentor other schools in our region. We will also provide testing before and after NP insertion to see if there are differences that further focus on NPs in the classroom.

**Summary**

Marshall University and HSTA have developed an NP program to teach college and high school students effectively. This program seems to increase learning with both groups. We will work to isolate the effects of NP mentors on NPs and HSTA students.

I want to thank the NPs who have given many hours to this project. I also thank Dr. Reynolds and Smith for their tireless efforts.

References

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