

START – addressing underrepresentation in STEM careers

When US neuroscientist Dr Luke H Bradley at the University of Kentucky helped design a STEM education programme for underrepresented students, his bold approach of interdisciplinary collaborations, near-peer mentoring, and teacher coaching promised to reshape a culture of negative reinforcement. The START Program embraces authentic research and training through direct contact between underrepresented students and teachers and a network of STEM professionals and mentors. When COVID-19 threatened the nascent programme, the reimaged programme achieved an even broader reach.

STEM subjects – science, technology, engineering, and mathematics – are increasingly important in any school education focused on the future. These subjects are the foundation of the myriad new and developing sectors needing the input of young people with the right skills and a passion for application and innovation. It is, therefore, disconcerting that so many young people are either denied access to these subjects or, for reasons beyond their realm, feel cut off from them. These underserved populations are critically in need of access to tailored mentoring and coaching to unlock barriers to further study and careers in STEM. Yet, STEM educational support and outreach programmes have varied results. However, one programme based at the University of Kentucky (UK) in the US is

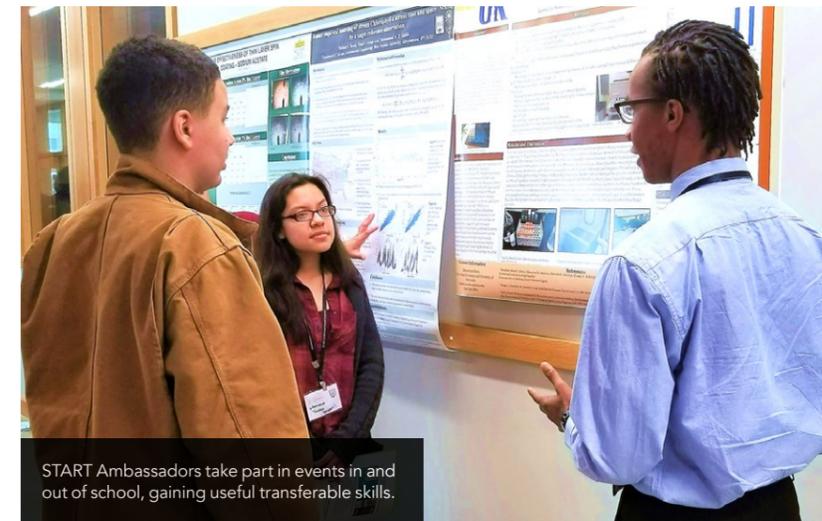
employing a bold idea with a broader scope, and its successes should be embraced further afield.

STEM OPPORTUNITIES THROUGH START

According to the US Department of Commerce Economics and Statistics Administration, employment in STEM occupations continues to grow much faster than in non-STEM occupations. This is helped in no small part by the numerous new sectors developing out of STEM-focused research. However, a snapshot of these growing sectors shows a glaring anomaly: underrepresentation in the workforce by populations such as first-generation, low-income, people of colour, women, and people with disabilities. To address this, UK has established a programme called START – STEM through Authentic Research and Training. The programme aims to address the shortage of such underrepresented populations in the STEM pipeline by improving the recruitment and retention of these key demographics. The brainchild of UK neuroscientist Dr Luke H Bradley, START stands out from other STEM education development programmes because of its principle of multiple reinforcing touchpoints.

POSITIVE REINFORCEMENT TOUCHPOINTS

STEM education development or outreach programmes can risk having minimum effect for correcting imbalances if they seek to plug a hole in the education and training system. Where START is smart is how it sees the bigger picture, identifies the



START Ambassadors take part in events in and out of school, gaining useful transferable skills.

multiple touchpoints for influence in the system, and focuses on reinforcing those touchpoints. The result is a better-served, more sustainable, and more representative ecosystem that should help address a STEM-education catch-22: STEM occupations can suffer diversity issues because those who are underrepresented do not see themselves – and cannot imagine themselves – in those occupations. As a result, they may have little motivation to study STEM subjects, leading to low graduation rates for underrepresented students in those subjects – a phenomenon known as ‘melt’.

Bradley and his START team realised the best way to break this negative reinforcement is to generate a sense of belonging by providing year-round authentic research opportunities, coaching, and professional development for those students and their teachers. Importantly, those who benefitted from the programme should feed back into it, creating multiple touchpoints of positive reinforcement – where underrepresented students begin to see people like themselves immersed in STEM subjects.

NEAR-PEER MENTORING

The START Program was initially developed in 2019 as an integrated outreach programme. Elementary and middle school students in participating schools would engage directly with UK STEM faculty members in hands-on, authentic STEM learning experiences to increase their STEM literacy. Knowing the importance of collaborations in the

success of such a programme, Bradley reached out to Space Tango, an aviation and aerospace component manufacturing company based in Kentucky. It was a good choice. It helped direct the START team to choose an inspiring theme for the students from underrepresented populations to ignite early interest in STEM: exomedicine – the study of medicine-related science in microgravity environments. Students would gain useful transferable skills, such as academic skills, social integration, and professionalism,

which would lay a solid foundation for a future career and further studies. The original idea was that students would continue participating in in-school and out-of-school programming, such as tours, demonstrations, and networking/invitations to campus STEM events throughout the year. Importantly, all those on the programme would carry the title ‘START Ambassadors’. Underrepresented senior high-school students would engage in year-round authentic learning laboratory experiences on campus at the university as ‘START Apprentices’. They would work directly with undergraduate students through a process of near-peer mentoring.

ADAPTING TO COVID-19

For a nascent programme relying on mentoring and direct contact between students and STEM professionals, the coronavirus epidemic could have been a disaster. But Bradley and his team came up with several clever workarounds that would ultimately prove beneficial for the programme’s reach. Firstly, the planned laboratory tours and demonstrations became virtual events. Without physical space limitations, these events could embrace larger audiences and tours could take place wherever a camera

The best way to break this negative reinforcement is to generate a sense of belonging in STEM for underrepresented students.



Luke Bradley and a group of students participating in the START Program.



START reinforces the multiple touchpoints for influence in the system, rather than simply trying to plug education and training gaps.



Tackling diversity issues in STEM means helping underrepresented students see themselves in STEM careers from a young age.

could visit. Students could follow live brain dissections, explore space research facilities, and watch clips from other STEM research fields on YouTube, all hosted by young staff with whom they could identify and who were willing to answer any questions they might have.

The START Program also introduced the 'Meet a Scientist' series, where students could interact virtually with scientists, increasing their opportunities to see someone like themselves in a STEM career. The START team designed these 'meets' to be friendly and down-to-earth, to make the scientists more accessible and help students imagine themselves in their position. Knowing that a professor had been an average student in their eventual field of expertise proved an eye-opener for students with pre-conceived ideas about the possibilities of STEM careers.

Because most of the students in the START Program were stuck at home, Bradley and his team arranged at-home learning kits focused primarily on exomedicine and space exploration. This was made possible through close collaboration with Higher Orbits, a non-profit that uses spaceflight to inspire and engage high-school students in STEM subjects. The kits included tools such as puzzles and projects and synchronous Zoom connectivity that allowed the students to meet with STEM professionals – including astronauts –

exposing them to opportunities they may never have considered.

DEVELOPING TEACHER SKILLS

Educators are a crucial focus of START – the primary touchpoints for underrepresented students in STEM. Bradley identifies the essential role teachers play in aiding the recruitment of underrepresented populations in the STEM pipeline and the benefits of improving their skills in coaching

Quick thinking and creativity in the face of COVID-19 restrictions saw the START Program team pivot to online training.

and mentoring for achieving this goal. The idea behind the START Teacher-Scholar Program is to support STEM teachers through workshops where they can gain authentic research lab experiences, attend customised training, and gain access to a variety of additional opportunities for professional growth and networking within the STEM community. Importantly, those on the programme near-peer mentor others, developing positive reinforcement to help break the 'melt' effect of underrepresented students losing interest in STEM subjects. Quick thinking and creativity in the face of COVID-19 restrictions saw the START Program team pivot to online training. Mentors were always on-hand via Zoom and other online platforms to guide teachers

through the programme and on to become mentors themselves.

One of the most exciting developments in the START Program was a webinar series themed around exomedicine, called 'Humanity in Deep Space'. It gave all START participants – teachers and students – an opportunity to get together for a series of web panels that brought together experts from various STEM and non-STEM disciplines to discuss human space travel and establishing deep-space civilisations. Few things encourage young people to embrace STEM subjects better than a purpose built upon imagination.

CULTURE CHANGE FOR DIVERSITY

START has a simple but clever premise: shifting the culture instead of plugging holes in the system. Tackling diversity issues in STEM occupations means helping underrepresented students envision their future in STEM from a young age. It means empowering teachers to encourage them and developing a network of mentors for students and teachers alike. And at all touchpoints, collaboration should be interdisciplinary and authentic, reaching out to varied STEM sectors and researchers eager to encourage young people, while focusing on diversity in outreach and representation.

The University of Kentucky START Program could have failed in the face of COVID-19, if it weren't for the creativity and determination of Bradley and his team and their seamless shift to a hybrid model. Importantly, teachers and students from underrepresented populations in STEM will additionally be integrated into tailored university support programmes, supporting their professional development and helping overcome potential barriers they may face. In the end, START not only managed to reach more students in the community than possible with face-to-face interactions alone, but also produced a programme that can be adopted by other institutions locally, regionally, and nationally to address this critical gap in the STEM pipeline.



Behind the Research

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Research Objectives

Luke Bradley and team are working to improve the recruitment and retention of underrepresented populations in the STEM pipeline and early interest in STEM for first-generation and underrepresented populations.

Detail

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Bio

Dr Luke H Bradley is a Chellgren Endowed Professor and Acting Chair of the Department of Neuroscience at the University of Kentucky, US. Involved in numerous community P12 STEM education and outreach activities, he founded START – a university-community partnership for recruiting and retaining first-generation and underrepresented populations in STEM.

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Collaborators

START Team (Dr Margaret Mohr-Schroeder, Dr Anthony Sinai, Rebecca Rudd, Fara Williams, Julie Bradley, Dr Michael Lauer, Brittany Derr, Molly McAndrew), The University of Kentucky, Fayette County Public Schools, The Academies of Lexington, STEAM Academy, Space Tango, Advance Kentucky, Kentucky Science & Technology Corporation, Higher Orbits, and Humanity in Deep Space.



References

Bradley, LH, Derr, BN, Durbin, CE, et al, (2021) STEM through authentic research and training program (START) for underrepresented communities: adapting to the COVID-19 pandemic. *J STEM Outreach*, 4(4), 1–9. doi.org/10.15695/jstem/v4i4.01

Personal Response

What lessons from the first few years of START would you like to share with other universities wishing to design similar programmes?

“ Don't try to do everything. Take advantage of existing strengths and programmes through partnering. ”



The first START Apprentices graduated from high school and all plan to attend the University of Kentucky in the fall to study STEM-related fields.



START Ambassadors and Apprentices interact throughout the programme to help build programme identity and a sustainable pipeline.