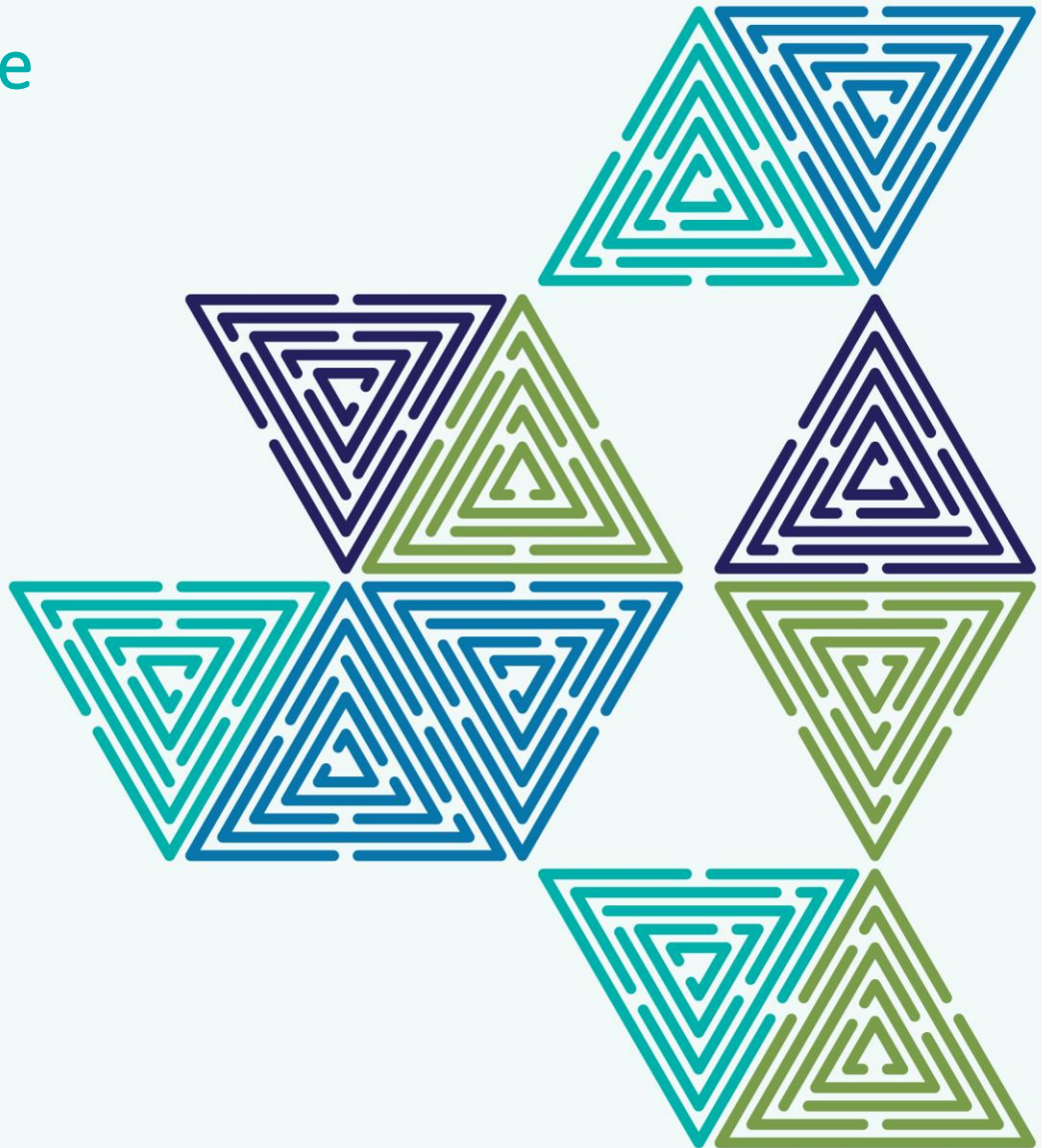


MOTIVATORS AND BARRIERS OF STEM CLUB ENGAGEMENT

Insights from the Robotics
Challenge



EngineeringUK
INSPIRING FUTURES TOGETHER

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Introduction

Research tells us that one-off interventions in STEM outreach may not be enough to support students into engineering and technology careers, but the pressure on school timetables makes it difficult for many to provide more in-depth or repeat STEM activities outside of the curriculum.

One common way that schools address this is through science, coding and other STEMbased clubs, operating outside formal teaching hours. While this provides more opportunity for students to engage in a broader range of hands-on activities, we want to understand the limitations, as well as the strengths, of relying on an extra-curricular club model for STEM engagement.

In 2022, we commissioned [Everfi](#) to conduct a literature review and qualitative research with students and teachers to find out more about the barriers and benefits of STEM clubs as a vehicle for engagement activity, with a particular focus on the [Robotics Challenge](#).

The EEP Robotics Challenge

The EEP Robotics Challenge was a team-based competition for students aged 11 to 14, open to schools across the UK. Teams worked together to complete a series of missions by building, programming and controlling autonomous LEGO® robots. Teams competed in heats across the UK, to secure a spot at the UK final, which used to be hosted at The Big Bang Fair.

The 2022/23 academic year was the final year for the Robotics Challenge programme, led by EngineeringUK, and funded by the Helsington

Foundation in partnership with the Royal Air Force and Network Rail. EngineeringUK has delivered the programme for six years, reaching over 50,000 students across the UK.

The programme aimed to encourage a wider diversity of students to have a fun experience with robotics and coding, to develop hard and soft skills needed in future engineering careers, and to consider pursuing careers in engineering and technology in the future.

The programme offered virtual training for teachers, kit for building the robots and a challenge mat for each participating school. The programme was flexible for schools, allowing them to engage students in a range of different ways, including as a whole-class activity.

It was common for schools to run Robotics Challenge activities through an extracurricular STEM club, whether pre-existing or established specifically to take part in the programme. Given this, the programme team was keen to understand the strengths and limitations of delivering in this format and whether any adaptations were needed to ensure that the Robotics Challenge was achieving its aims of widening participation in engineering and technology activities.

About the research: the research was conducted by Everfi in spring 2022, in two phases:

1. Desk research was used to review key findings on the use of robotics and STEM clubs
2. Focus groups and interviews were carried out with 28 students and 17 teachers, both those engaged and unengaged in the Robotics Challenge

Key motivators for student and teacher engagement in STEM outreach

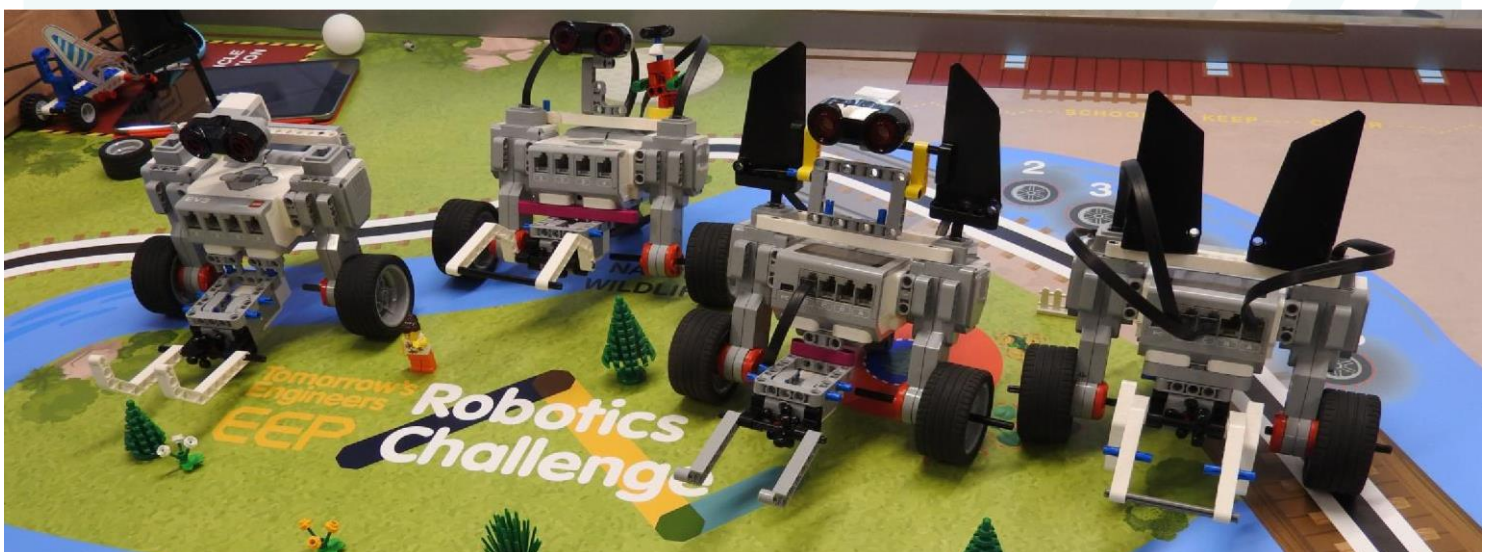
There are a range of motivators for students to engage with STEM enrichment activities. The research found that almost all participating students enjoyed the practical and hands-on aspects of STEM related subjects and computer science. These aspects allow for a change to the typical classroom setting, and for group work, which students enjoy. A few of the unengaged students from the focus group mentioned they were more likely to join STEM clubs if they focused on experiments. This reflects findings from across our own programme evaluations which highlight how interactive elements are preferred by students.

Another motivator for students was working in friendship groups or pairs. The research found that allowing students to work this way made participants feel more comfortable with tricky subjects and gave them the opportunity to learn directly from each other.

While all participants understood how processes and problem solving are a component of STEM subjects, boys were more positive about the idea of processes in STEM, as well as using trial and error approaches to solve problems. This was a reason for which they tended to be more interested in STEM or attending STEM clubs.

Motivators for teachers include the cost and quality of resources as well as the return on investment from clubs. The research found that high-quality resources and kit that is free or of little cost increase the likelihood of schools taking part in STEM programmes. In particular, teachers tend to favour free programmes, (considering schools' limited budgets), well-known creators associated with high-quality initiatives, and programmes that include quality CPD, hands-on resources, and clear links to the curriculum so that teachers don't have to do this themselves. If additional kit is provided, this also enables teachers to engage more groups of students in hands on activities.

Additionally, clubs that offer a clear return on investment, such as improved college or university uptake, can be favoured by a school's senior leadership team. Schools are looking for STEM clubs where students can gain significant experiences or something different from classroom lessons. This is to provide additional opportunities to support students with university applications, or similar.



Key barriers for students and school engagement in STEM outreach

STEM clubs can lack diversity and tend to be more popular with boys, with few exceptions.

The research found that a key reason girls didn't enjoy STEM subjects was their perception of STEM as lacking creativity. Girls tended to prefer more creative subjects like art and design. Terminology may also be a barrier. One group of students from the focus groups found the term 'STEM' confusing, highlighting that it doesn't showcase creative opportunities and is potentially alienating.

Teachers felt that some sciences attract an equal number of girls and boys, but extracurricular STEM clubs struggle to engage a diverse group of students. These tend to be more popular with boys and often don't attract students from various ethnic and economic backgrounds. Their views on barriers for students include girls' reluctance to join if friends aren't involved, and students from low socio-economic backgrounds often having after-school commitments.

Additionally, themed STEM clubs can affect engagement. For example, in some schools, robotics clubs mostly attracted boys, while nature clubs were a more popular choice for girls and one school shared that no girls attended their engineering club.

Time, resources and information are a barrier for teachers when diversifying STEM clubs.

Teachers lack time to create resources and opportunities for all students, relying instead on ready-made materials and legacy initiatives. Some also lack awareness of issues girls face and what might engage them. The pandemic further reduced available STEM activities, which teachers felt reversed progress in attracting more girls to STEM subjects in some schools. Additionally, STEM departments rarely collaborate. There could be opportunities for teachers of creative subjects, like design and technology, to work with subjects more focussed on process, like computer science, to increase uptake.

“Something that we're trying to do more of now is have more compulsory full day STEM days so that everyone has to get involved in it. That way, maybe we'd see that if the girls are attending with their friend group, it allows them to demonstrate that it is actually fun [...] and then the whole friend group would go along to a robotics club or a STEM club more readily” - Teacher

At EngineeringUK, we plan to use this learning as we continue working on ways to engage schools in STEM activities. We aim to help schools overcome these barriers by:

Creating programmes that nurture the different links between subjects, or making these links more explicit in existing initiatives. Through this approach we hope to broaden the general appeal of STEM subjects to girls and those who do not think of themselves as being traditional STEM thinkers. This could include emphasising links between STEM and creativity or focusing on topics that are more appealing for young people under-represented in engineering and tech.

Supporting schools to recover from the losses caused by the pandemic, by helping schools to set up and advertise clubs to underrepresented groups. This could include avoiding the term 'STEM' when advertising clubs, instead highlighting the skills and broader learning strategies gained through STEM activities.

Exploring how to best widen participation to STEM clubs by taking a whole class approaches to **delivery**. This could include subject lessons or whole day activities. We are currently piloting new cross-curriculum resources focused on climate action - see [Climate Schools Programme](#) for more information.