Robotics Challenge: Introducing Robotics lesson

Evaluation using a pre-post survey approach

June 2023

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Introduction

In October 2022, the Introducing Robotics lesson was launched as part of EngineeringUK's Robotics Challenge[1] programme. This resource is a stand-alone optional session that introduces secondary school students to robotics and aims to raise their awareness of careers in robotics and engineering.

The Introducing Robotics lesson was developed in 2022 by EngineeringUK in partnership with EVERFI and a panel of subject matter experts and teachers.

The aim of the lesson is to encourage more young people, especially those from groups underrepresented in STEM, to think differently about robotics and to sign up to the Robotics Challenge programme. As such, teachers were asked to deliver the lesson during school time in order to reach young people who might not have considered robotics before.

To understand whether the lesson has an impact on students' interest in taking part in robotics or coding activities, we piloted a pre and post evaluation in the 2022/23 academic year. EngineeringUK recruited a sub-sample of teachers signed up to the Robotics Challenge programme to deliver the lesson and take part in the evaluation. This consisted of teachers distributing a paper-based postcard survey to their students, asking them to complete one side at the beginning of the lesson and the other side at the end. The approach helps us to understand the change in interest in robotics or coding activities that may be created by the lesson.

Alongside the student postcard survey, teachers were asked to complete a feedback form after they facilitated the lesson. This enables us to understand how the lesson was delivered, who it was offered to and teacher's overall views of the lesson.

This report shares the findings from the pre and post evaluation pilot, based on data from both students and teachers. The focus is on the key measure of interest that we anticipated could change as a result of the lesson as well as insights from teachers to improve future delivery. A guide to understanding the data is included in the appendix of the report.

We received a total of 592 responses from students at 25 schools, ranging from 5 to 58 responses per school. The low number of responses in one school particularly may introduce some selection bias and this is a weakness of the evaluation.

Beyond presenting the findings from the data analysis, this report provides reflections on the evaluation pilot and how data collection might be strengthened in future.

1. Robotics Challenge is a STEM programme for young people aged 10 to 14. It involves school-based activities for students to learn how to build, program and control autonomous LEGO® robots. Schools can then organise teams to compete in the Robotics Challenge heats across the UK, whose winners compete at the finals as part of EngineeringUK's annual Big Bang Fair.

Participating schools

Schools selected to take part in the pilot evaluation were asked to deliver a 60-minute version of the lesson during classroom time.

The Introducing Robotics lesson was made available to schools participating in the Robotics Challenge programme. Teachers could access this optional lesson plan online, alongside other programme resources available to support the delivery of programme activities in schools.

Lesson delivery

Introducing Robotics can be delivered in different ways: during assembly time (15 to 20 minutes), classroom time (60 minutes) or classroom time plus one or two of the additional extension activities (30 minutes each). However, we cannot expect that shorter assembly time lessons will make a difference to students that we can capture, which is why in our evaluation we only focused on schools who were aiming to deliver at least one classroom time lesson.

Participation in the evaluation

Each teacher was given one class pack with 30 student survey postcards and could request up to 3 class packs in total. Data was collected between November 2022 and April 2023.

A total of 40 schools, 20 EngineeringUK priority schools (meaning those who meet our EDI Criteria[2]) and 20 schools who do not meet our EDI Criteria, were invited to take part in the pilot evaluation.

Overall, 25 schools sent back completed class packs (12 priority schools, 12 who do not meet our EDI Criteria) and one pack of completed postcards was received without school details.

Bursaries

In 2022/23, EngineeringUK offered financial support (£400) to 27 priority secondary schools who participated in the Robotics Challenge programme.

The primary aim of the bursary is to support schools in widening participation in the programme to involve more young people from groups underrepresented in engineering. It also aims to support schools to purchase robotics kits or to travel to take part in Robotics Challenge heats.

Given the aims of the bursary, schools who received this financial support were also required to run the Introducing Robotics lesson in classroom time (60-minute version). A sub-set of these schools was recruited to take part in the pilot evaluation.

The sample of schools selected for the evaluation consisted also of schools who do not meet EngineeringUK's EDI criteria and who therefore were not eligible to receive a bursary. These schools were given an incentive of £100 to take part in the pre and post evaluation.

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2. EngineeringUK defines as priority schools those who meet our Equity, Diversity and Inclusion (EDI) criteria, based on student population with higher numbers of groups typically underrepresented in engineering. For more details, see EngineeringUK EDI Criteria (tomorrowsengineers.org.uk).

Who responded to the student survey?

A total 592 students from 25 schools completed paper-based evaluation surveys. Participants were asked to fill one side of the postcard with the pre survey before the lesson and the other side with the post survey at the end. Responses were already matched as each young person had their own postcard to complete.

Most of the sample schools who sent back postcards were from England, with 3 schools from the remaining UK countries (one in each of Scotland, Wales and Northern Ireland). Half of the schools (12) meet EngineeringUK's EDI criteria, 12 do not meet the criteria and one package received did not include school details.

		Students responding to survey	
		Number	%
Total		**592**	
Year Group (n=587) [England / Scotland / Northern Ireland]	Year 7/S1/Yr 8	270	46%
	Year 8/S2/Yr 9	214	36%
	Year 9/S3/Yr 10	93	16%
	Year 10/S4/Yr 11	6	1%
	Post 16 [3]	4	1%
Gender (n=588)	Female	273	46%
	Male	301	51%
	Prefer to self-describe	3	1%
	Prefer not to say	11	2%
Ethnic groups (n=578)	Asian/Asian British	80	14%
	Black/Black British	26	4%
	Mixed or multiple ethnic groups	36	6%
	White	381	66%
	Other ethnic identity	18	3%
	Prefer not to say	37	6%
Disability (n=583)	Yes	61	10%
	No	401	69%
	I don't know	77	13%
	Prefer not to say	44	8%

3. Post 16 students were specifically from Special Educational Needs and Disabilities (SEND) schools in England where students who might be in older year groups are at a reading and comprehension level of earlier years.

How do respondents engage with tech activities?

We asked students a series of questions to explore their pre-existing engagement in technology related activities, including previous participation in the Robotics Challenge programme.

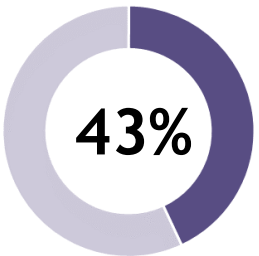
On average, students said they were already engaging outside of school in one of the 3 technology related activities that we asked about. Only 1 in 10 reported they took part in Robotics Challenge before.

Beyond collecting demographic data, we are also interested to find out about students' engagement in Robotics Challenge or other technology related type of activities before the lesson. This enables us to consider their experience in our analysis of any change in interest before and after the lesson.

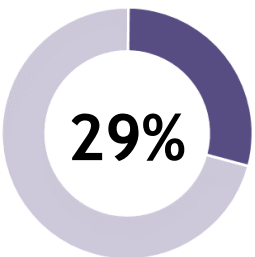
Nearly three quarters (74%) of participants said they had not taken part in Robotics Challenge before, while 16% we not sure whether they had participated or not in the programme.

Overall, 42% of students responding said they do not do any of the 3 technology activities indicated on the right. Over one third (35%), reported doing at least one of these activities and 23% do 2 or all 3 of the technology related activities.

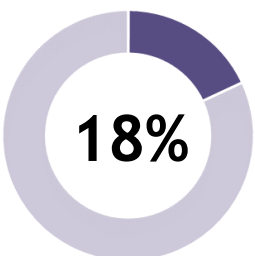
For the purpose of this report, we will be referring to different levels of tech activity engagement, low (for respondents who reported not taking part in any of the 3 technology related activities listed here), medium (for those doing one of the activities listed) and high (for those doing 2 or all 3 of the activities listed).



Go online to find out about technology and computer science (n=586)



Create their own computer games, website or animation (n=582)



Attend a science, technology, engineering or maths club (n=586)

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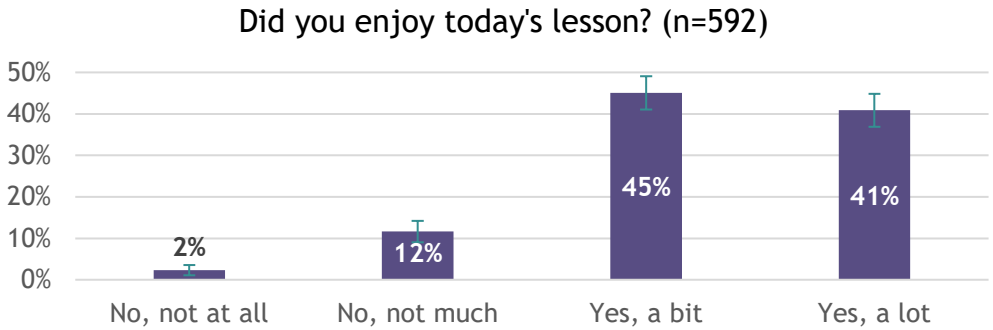
Student enjoyment of Introducing Robotics

The aim of the lesson to encourage more young people to think differently about robotics and consider taking part in future robotics activities is based on providing an experience that is enjoyable and engaging for young people.

Overall, most students (86%) enjoyed taking part in the lesson. Participant year group and previous engagement in technology related activities were predictors of the likelihood students reported enjoying the lesson.



Our analysis found that student year group and prior tech engagement are significant predictors of enjoyment of Introducing Robotics, when taking into account all other student characteristics.[4]

- **Year 7 students were over twice as likely to enjoy the lesson**, compared to Year 8 students (OR=2.52, 95%CI 1.23-5.15, p<0.05).
- **High tech engagement[5] was found to increase the odds of enjoying the lesson by 8 times,** compared with students with low prior tech engagement (OR=8.05, 95%CI 2.27-28.53, p<0.05).
- **Medium tech engagement[6] was found to increase the odds of enjoying the lesson by over 4 times,** compared with students with low prior tech engagement (OR=4.26, 95%CI 2.02-9.00, p<0.05).

Given enjoyment can be a motivator for continued engagement in technology related activities, it is not a surprising finding that prior engagement in the tech activities is also a predictor of the likelihood students enjoyed the lesson.

Encouragingly, findings suggest that the lesson may be equally enjoyable for students of different genders, ethnicities and abilities.

4. Logistic regression in this report controlled for student characteristics, including gender, ethnicity, year group, disability, prior tech engagement and prior participation in Robotics Challenge.
5. Refers to students who take part in 2 or 3 of the technology related activities we asked about outside of school (see 'How do respondents engage with tech activities?')
6. Refers to students who take part in one of the technology related activities we asked about.

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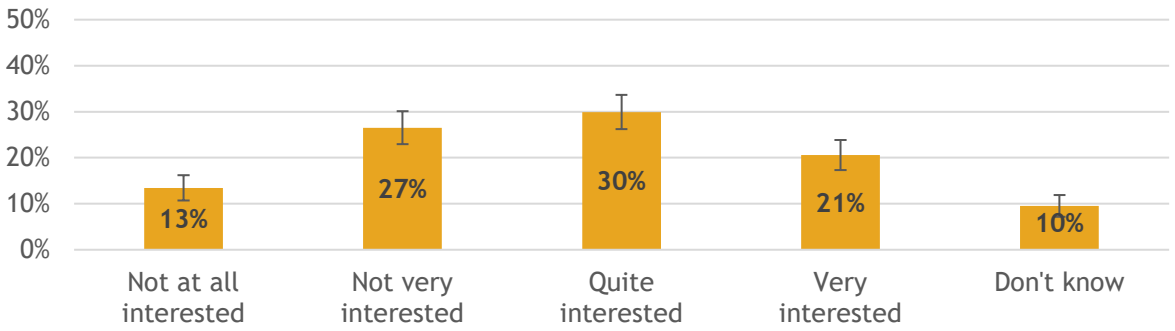
Before lesson: Interest in robotics or coding activities

Before the lesson, half of the students responding (51%) said they were quite interested or very interested in taking part in robotics or coding activities outside of lesson time. Asian students and those already engaged in technology related activities were more likely to answer positively.

How interested are you in taking part in robotics or coding activities outside of lesson time? (n=588)



Beyond overall student interest in robotics or coding activities, we also wanted to find out whether this is influenced by various characteristics, including gender, ethnicity, disability, year group, prior technology engagement or participation in Robotics Challenge.

We found that student ethnicity and technology engagement remain significant predictors of the likelihood that a student is interested in robotics or coding activities outside of lesson time, before Introducing Robotics.

- **Asian students were over twice as likely to be interested in taking part in robotics or coding activities**, compared to white students prior to the lesson (OR=2.30, 95%CI 1.03-5.17, p<0.05).

- **High tech engagement was found to increase the odds of being interested in robotics or coding activities by over 22 times,** compared with students with low prior tech engagement before the lesson(OR=4.63, 95%CI 2.00-10.70, p<0.05).

- **Medium tech engagement was found to increase the odds of being interested in robotics or coding activities by 6 times,** compared with students with low prior tech engagement before the lesson (OR=6.45, 95%CI 3.61-11.51, p<0.05).

These findings may not be that surprising considering prior interest could have been motivating students to already engage in technology related activities outside of lesson time, or these activities students engaged in prior to Introducing Robotics could have been fostering student interest over time.

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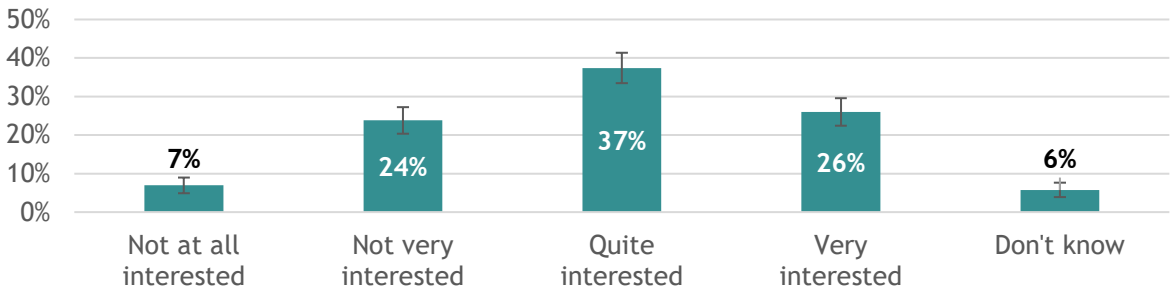
After lesson: Interest in robotics or coding activities

Introducing Robotics aims to increase young people's interest in engaging in robotics or coding activities. After the lesson, 63% of students reported being quite interested or very interested in taking part in robotics or coding activities outside of lesson time. Those already engaged in technology related activities were more likely to answer positively.

Having taken part in today's lesson, how interested are you in taking part in robotics or coding activities outside of lesson time? (n=588)



Preliminary analysis suggested that, after taking part in Introducing Robotics, male students and Asian students were more likely to be interested in robotics or coding activities, compared to female and white students respectively. However, additional analysis indicated that these differences can be accounted for by students' prior engagement in technology related activities.

In fact, we found that the only student characteristic associated with being interested in out of school robotics or coding activities after the lesson was prior tech engagement.

- Students with **medium tech engagement were 4 times** as likely, and students with a **high tech engagement were 42 times as likely, to be interested in robotics or coding activities** outside of lesson time, compared to students with low prior tech engagement after the lesson.

(Medium: OR=4.22, 95%CI 2.41-7.38 $p<0.05$; High: OR= 42.16, 95%CI 9.59-185.30, $p<0.05$).

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Change in interest in robotics or coding activities

After the lesson, students overall were 70% more likely to say they are interested in robotics or coding activities than they were before.[7]

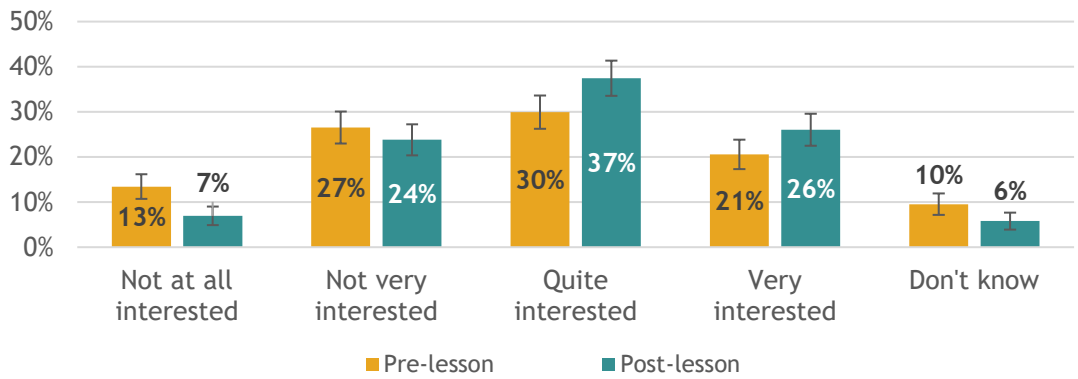
Before the lesson, just over half (51%) of students said they were interested in doing robotics or coding activities outside of lesson time.

There is a slight increase following the lesson to 63%. Nearly one third (30%) of students rated their interest as higher following the lesson, and 8% rated it as lower.

More than half of students (62%) did not change their response to this question after the lesson.

However, encouragingly, the chart below does suggest that **fewer students reported being not at all interested in these activities after the lesson** (going from 13% before the lesson to 7% after the lesson)**.**

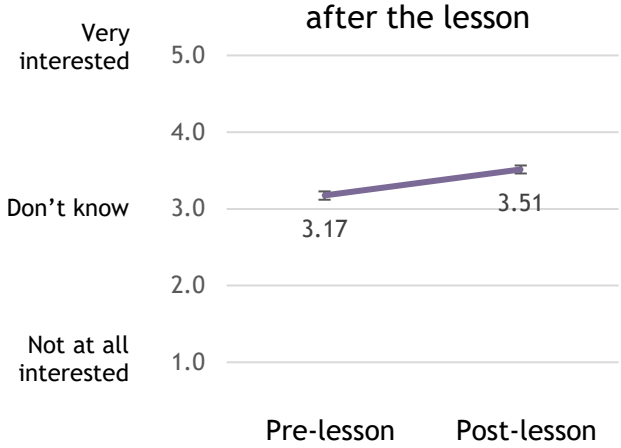
Interest in robotics or coding activities before and after Introducing Robotics (n=588)



We also found a small but significant increase in mean scores for interest in robotics or coding activities before (pre-lesson) and after (post-lesson) Introducing Robotics.[8]

This suggests that **there is a positive shift in interest along the scale among students who attended the lesson.**

Mean scores before and after the lesson



7. Students responding, 'Quite interested'/'Very interested' vs all other responses (OR = 1.70 95%CI [1.35, 2.15]).
8. A paired sample t-test was conducted for this analysis (Pre-lesson: M=3.17, sd=1.37; Post-lesson: M=3.51, sd=1.29, (t(584)=9.02, p=<0.05)).

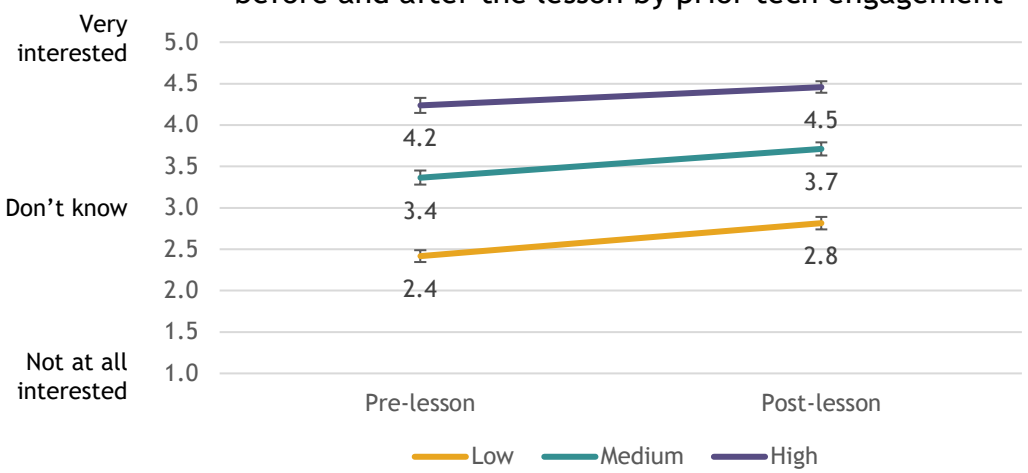
Change in interest in robotics or coding activities

Beyond understanding the likelihood that students would be more interested in robotics or coding activities after the lesson, we explored whether a positive change might be influenced by young people's demographic characteristics, prior engagement in tech or Robotics Challenge or the way the lesson was delivered by teachers.

Our analysis found that **students with prior low tech engagement were over twice as likely to have reported an increase in their interest in robotics or coding** activities after the lesson, compared to those with high tech engagement.[9]

This does not mean there was no increase in interest among young people with high or medium tech engagement. In fact, **the increase in mean scores from the pre-lesson survey to the post-lesson survey was significant for students with all levels of prior tech engagement.**[10]

Mean scores for students' interest in robotics or coding activities before and after the lesson by prior tech engagement



We also explored whether the different ways in which the lesson was delivered in schools may influence positive change in young people's interest in robotics or coding activities.

However, we found there was no association between positive change in interest of robotics or coding activities and the following factors: when the lesson was delivered, whether students could choose for themselves to take part or were selected by teachers or whether schools met our EDI criteria.

9. Positive movement across the scale vs negative or no movement (OR: 2.62 95%I [1.24,5.56]).
10. A paired sample t-test was conducted for this analysis: Low tech engagement (Pre-lesson: M=2.42, sd=1.14; Post-lesson: M=2.81, sd=1.21, (t(214)=6.78, p<0.01); Medium tech engagement (Pre-lesson: M=3.37, sd=1.27; Post-lesson: M=3.71, sd=1.16, (t(207)=5.31, P<0.01); High tech engagement (Pre-lesson: M=4.24, sd=1.07; Post-lesson: M=4.46, sd=0.84, (t(134)=3.06, P<0.01).

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Introducing Robotics delivery

Understanding how the lesson was delivered in schools is key to contextualise the findings presented in this report and whether we can attribute any change we see to the lesson. Additionally, teacher feedback is useful to understand the extent to which the lesson was delivered as intended in classroom time.

The way teachers delivered the Introducing Robotics lesson varied across schools participating in the pilot evaluation, with sessions lasting anywhere between 30 minutes to 2 hours. Most teachers who ran a lesson during classroom time did so in a computer science lesson.

For the most part, teachers delivered between 1 to 2 lessons by the time they shared their feedback. They also reported involving several students, ranging from 5 to 180 (on average 36 students per school). See Annex B for more on participating students and their demographic characteristics.

Students were selected in different ways to take part. Some involved classes taught by the teacher we contacted. Other teachers gave students the choice to take part. In some cases, students were selected based on high attainment in STEM related subjects.

		Teachers
		Number
Total responses		22
Lesson delivery	During lesson time	13
	During tutor time or assembly	1
	During lunchtime	4
	Out of school time (e.g., during an after school club)	7
	Other[11]	3
Student selection	Whole key stage 3	0
	Whole year group(s)	2
	Class selected based on high levels of attainment in STEM subjects	4
	Class selected based on another criteria[12]	9
	Students could choose for themselves	8
	Individual students were selected/invited in another way[13]	2

Note: numbers do not add to 22 as respondents had the ability to select more than one answer option.

11. Responses specified during wellbeing, an animation club and pulling students out of a variety of lessons.
12. Responses specified classes taught by the teacher involved in Robotics Challenge, student interest and behaviour, classes where there was available time in their scheme of learning and, in the case of one SEND school, students were selected based on ability.
13. Responses specified selecting individual students based on interest in programming technology.

Who responded to the teacher feedback form?

Alongside the student pre and post evaluation postcards, teachers were also asked to complete a feedback form so we could understand how the lesson was delivered in schools as well as capture teachers' views of the lesson.

Teachers were invited to complete a paper-based feedback form or could share their responses online using QR codes sent in the class packs with the student postcards.

Most of the respondents thought computing or computer science, design and technology or combined science, with nearly half indicating they teach more than one STEM subject.

		Teachers
		Number
Total responses		22
Subject taught	Computing/Computer science	11
	Design and technology	5
	Combined Science	5
	Maths	4
	Physics	3
	Chemistry	3
	Engineering	3
	Biology	2
	Other STEM subject(s)	0
	I do not currently teach any STEM subjects	1
School information	Meets EUK's EDI criteria	12
	Doesn't meet EUK's EDI criteria	12

Note: numbers for 'Subject taught' do not add to 22 as respondents had the ability to select more than one answer option. Information on EDI criteria is based on school name, not teacher response.

Teachers experiences of Introducing Robotics

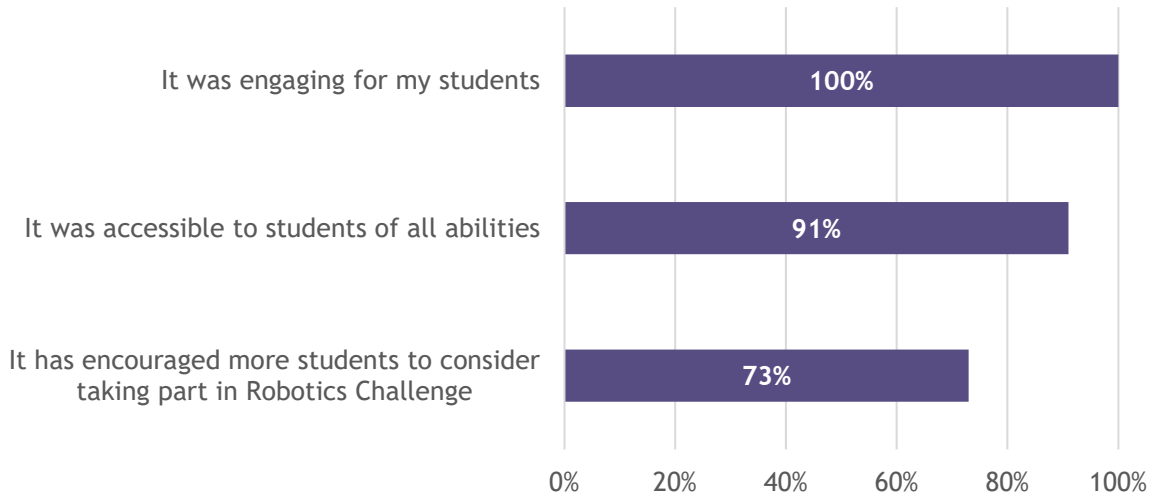
Teachers who responded were extremely positive about their experience of Introducing Robotics. Nearly all respondents rated the lesson as 'excellent' (12 teachers) or 'good' (8 teachers).

Teachers overall agree that the lesson was engaging for their students and that it was accessible to students of all abilities, for the most part. Respondents who disagreed with the latter statement provided additional feedback and suggestions for making the content more accessible:

- One teacher mentioned the background of the slides was not accessible for visual stress students and students who have dyslexia. Editable slides where the background could be changed by a teacher may be helpful.
- Another teacher reported being from a special needs school and highlighted that their students required a lot of adult support. Tailoring lesson activities to individual needs may be helpful in these cases (e.g., via problem solving activities for those with a specific disability).

Fewer teachers agreed the lesson encouraged more students to take part in Robotics Challenge. This could be related to when the lesson was delivered in the year, when teachers completed the feedback form and how this all fit in their timelines for Robotics Challenge programme activities.

Proportion of teachers who agreed that Introducing Robotics is engaging, accessible and encouraging for students (n=22)



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Learning for improvement

Teachers were asked what they liked about the lesson and what they would do differently if delivering the lesson again. They also shared suggestions about how we could improve the lesson overall.

What teachers liked about the lesson

Teachers liked the resource overall, highlighting that the presentation, slide notes and guiding information is clear and easy to use.

They also reported the activities are engaging, interactive and fun for their students. Teachers particularly highlighted the following elements: 'programming your classmate' activity, examples of real-world applications of robotics and ethical discussions on robots.

What teachers would do differently

Teachers had different perspectives on how they would deliver the lesson again in future. Some mentioned they would run it with more students, whereas others considered taking it off curriculum (e.g., running it for a STEM club) to allow students to have more time for the practical activities.

Other considerations teachers mentioned were related to resources available to deliver the activities. For example, they mentioned they could consider using larger rooms, including LEGO® or robotics kit or printing some of the slides for students to see and take home.

Some also highlighted they would like to be able to include more hands-on activities or small group work, but this would depend on the resources and time available.

The students especially liked the 'Program your classmate' section. They liked that they could apply what they know to the task in an accessible way.

I did a formal version with the bigger group to get more reach - but actually, I would have done the expanded workshop to the smaller group in hindsight - I just wanted it to be accessible for girls and within the club there are none.

[I would] deliver it to a different group of students (perhaps a whole year) rather than students self-selecting to take part.

What EngineeringUK could change

There were a variety of suggestions related to the presentation, careers information and activities. Some teachers mentioned adapting the presentation to be more interactive (e.g., including videos of examples of robotics and related careers). Others proposed reducing the words on the slides and giving more opportunities for students to share their own knowledge. Some teachers also suggested including more practical activities, including programming, coding activities or use of kit.

Conclusions and recommendations

This report shows the extent to which we can see change in the views of students following the Introducing Robotics lesson based on findings from an initial pilot evaluation. Both teachers and students shared their positive view of Introducing Robotics. Overall, findings provide an encouraging picture, with signs of change in interest in robotics or coding activities after the lesson.

Experiences of Introducing Robotics

Students reported they enjoyed taking part in the lesson (86%). Teachers rated Introducing Robotics highly (20 out of 22), all agreeing it is engaging for their students.

The lesson is particularly enjoyable for young people who are in Year 7 and who engaged with one or more of the technology related activities we asked about before the lesson (meaning medium and high prior tech engagement). However, our findings also suggest it may be equally enjoyable for students of different genders, ethnicities or abilities.

Delivery of the lesson

The way teachers delivered the lesson varied across schools, with sessions lasting different amounts of time and students being selected in distinct ways. While some taught the lesson during their classroom time (mostly in computer science lessons), in other cases, teachers facilitated the lesson only with students who are high achieving in STEM-related subjects or smaller groups of self-selected students (e.g., in STEM clubs or hand-picking students out of other lessons).

Overall teachers especially liked practical and hands on activities, in some cases considering adding more of these if they were to run the lesson again. However, time and resources remain key considerations for what is possible for teachers to do in schools.

Introducing Robotics does increase young people's interest in robotics or coding activities

There is a small but significant increase in young people's interest in robotics or coding activities following the lesson. Low prior tech engagement, in particular, was found to be a predictor of positive change in interest. This highlights the importance of running the lesson with students who might not have otherwise had the opportunity to engage in robotics or coding activities or even considered taking part in these before.

More than half of students responding did not change their response between the pre and post survey, but encouragingly fewer reported a more negative response after the lesson. This could suggest the lesson alone may not be enough to lead students to take next steps after the lesson and participate in additional robotics or coding activities.

Conclusions and recommendations

Our evaluation findings suggest the most immediate outcome of the lesson was achieved. However, there are several areas of learning from this pilot to inform future delivery of similar programmes.

Careers information

There were a variety of suggestions from teachers on how to improve the lesson. Beyond including more hands-on activities, some teachers highlighted the need for additional careers information shared in a more interactive way, for example via videos of uses of robotics and careers in related fields.

Consultations with SEND schools

There is a wide range of abilities among students with special needs and related considerations for tailoring programme delivery. It is essential that SEND schools are consulted for an inclusive and engaging lesson. A place to start could be ensuring resources can be edited by teachers to make slides easier to read for their students.

Clear communication

Given the different ways teachers delivered the lesson, additional guidance may be needed to highlight the benefits of running these activities with students who might not already be engaging in technology related activities.

However, in this case, the differences in delivery could be related to the fact that the teachers we recruited were planning on running Robotics Challenge activities in STEM clubs. It was also the first year the lesson was made available to teachers, and some may have preferred to start running an Introducing Robotics lesson with smaller groups of students.

Findings from this evaluation highlight that teachers are considering delivering the lesson again in some cases with larger groups of students or year groups and in other cases with smaller self-selecting groups.

Future evaluation may want to focus on exploring in more detail teachers' considerations when engaging in these types of programmes and reasons for not running similar kinds of lessons during classroom time. We are aware that since Covid-19, schools continue to face challenges and curriculum catch-up remains a key priority in schools. Additionally, teachers are time-poor and some schools may not have the necessary resources available.

Conclusions and recommendations

There are several considerations when interpreting the findings as well as learning for future evaluations.

Pre and post data is essential for us to see actual change in students' views before and after the lesson. Without a control group, we have to be cautious about saying that any change is caused by the lesson. But given the short time between pre and post data collection it is likely that change may be the result of the lesson and related activities rather than a more general trend.

Change over time

Findings of this initial pilot are encouraging and do show a positive change in interest of robotics or coding activities immediately after the lesson. However, as we know from the evaluations of similar EngineeringUK interventions and wider evidence available, multiple STEM outreach encounters are needed to build on students' interest over time. This lesson may contribute towards students' motivation to pursue STEM related activities, but they also need multiple opportunities to engage in STEM outreach and build their capacity over time. Future evaluations could consider a third point of data collection.

Sample

The numbers of students in this pilot evaluation are fairly modest, but they do allow for meaningful analysis. A larger data set is more likely to pick up small but real shifts and to avoid bias.

In particular, the number of schools involved in the pilot is small, and so we cannot be very confident that a similar picture would be seen across the other schools who deliver Introducing Robotics.

Survey questions

The survey questions were adapted from the questions already being used in the wider programme evaluation of Robotics Challenge. However, these have not been tested for reliability as a repeat measure. Focusing on one outcome of interest made it possible to limit our survey only to the essential questions needed and encouragingly data received was nearly entirely complete (99% completion rate for pre survey and 98% completion rate for post survey).

Data collection

It is more work for busy schools to organise data collection at 2 time points for their students. However, providing paper-based postcards with very short surveys were received positively by teachers. We collected a larger number of student responses from fewer schools than collected previously for Robotics Challenge programme evaluations.

For future years we will look to review and more robustly test the survey questions and continue to explore how postcard surveys can be used in our data collection.

Annex A. Guide to understanding the data

The aim of a pre and post approach is to offer us a more robust measure of change, acknowledging that students are at different starting points, but also a way to explore whether different groups of students experienced a different shift on our measure of interest. In this report we provided analysis to show to what extent students' views changed following the lesson.

This evaluation is designed around one key measure of interest in robotics or coding activities. This item follows a Likert scale structure, allowing students to give a response on a 4-point scale with a strong negative on one end and a strong positive on the other. We also included a 'don't know' response option, which for the purpose of our analysis was coded as a neutral response. To make sense of the data, we provided 3 ways of comparing the pre-lesson and the post-lesson responses. This helps us to develop a better understanding of any shift.

The odds of giving a positive response

Since to achieve our desired impact, students need to be interested in doing robotics or coding activities, we first looked at the data using a binary approach, comparing positive responses (e.g., very interested and quite interested) with negative or neutral responses (e.g., not at all interested, not very interested and don't know). We then calculated the odds of students giving a positive response before the lesson and after. We also calculated the odds separately for different groups of students and how they've been selected to take part in the lesson in their school.

Positive or negative movement

A second way of looking at the data was to compare individual scores before and after the workshop to see whether students are moving towards a more positive response or a more negative response. This may be from any starting position and by any distance. This is important to consider, as the lesson may move some students further away from being interested in robotics or coding activities as well as closer towards it. We also calculated the odds of positive movement, comparing students who reported a positive movements across the scale to those who reported no change or negative movement.

Comparing mean scores

Finally, to assess whether there has been any change across the whole scale, we coded the scales using numeric values from 1 (which is 'not at all interested') to 5 (which is 'very interested'), with 3 as the 'don't know' response. We then calculated and compared the mean scores using paired-sample t-tests. This allowed us to see whether there has been any genuine shift along the whole scale.

Annex B. Demographic data

Table 1. Demographic data of students participating in Introducing Robotics provided by teachers at 22 schools

Demographic categories		Average number of students reported by teachers	Range of responses
Gender			
	Male	18	0 to 92
	Female	16	0 to 80
	Non-binary or other self-description	0	0 to 0
	Teachers don't know	2	0 to 50
Ethnic group			
	Asian/Asian British	4	0 to 28
	Black/Black British	2	0 to 15
	Mixed or multiple ethnic groups	2	0 to 24
	White	23	0 to 156
	Other ethnic identity	1	0 to 4
	Teachers don't know	5	0 to 50
Year group			
	Year 7/S1/Year 8	21	0 to 180
	Year 8/S2/Year 9	11	0 to 50
	Year 9/S3/Year 10	3	0 to 27
	Teachers don't know	1	0 to 10
Disability			
	Disability/impairment	7	0 to 62
	Teachers don't know	6	0 to 29
Total number of students		**36**	**5 to 180**