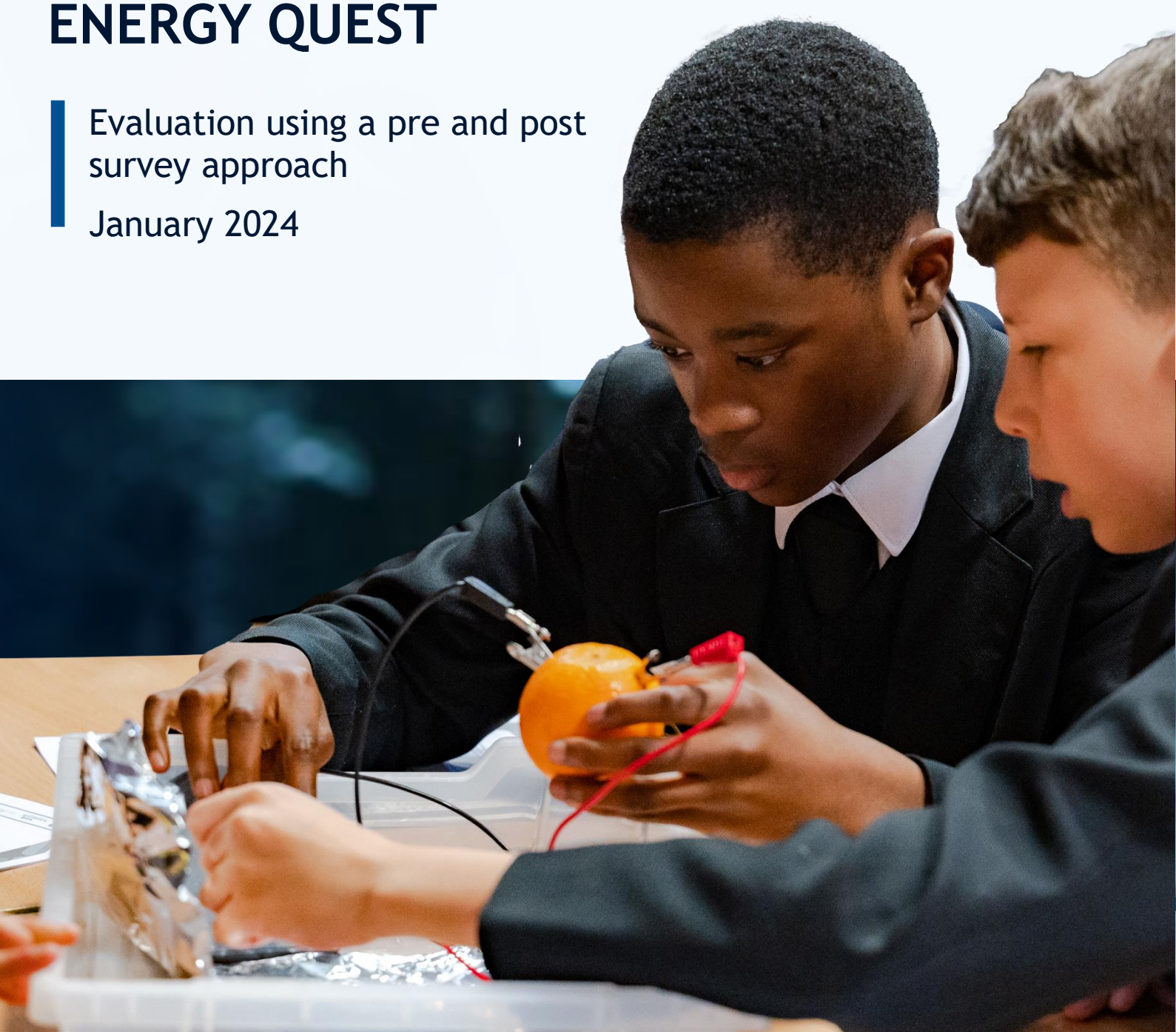
EngineeringUK
INSPIRING FUTURES TOGETHER

ENERGY QUEST

Evaluation using a pre and post survey approach

January 2024



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Energy Quest (EQ) is a curriculum-linked workshop aimed at fostering an understanding of sustainable and renewable energy in engineering. It aims to also inform and inspire young people about engineering careers. The workshop is delivered via a up to 2-hour session for Key Stage 3 students (ages 11 to 14) across the UK, with a focus on engaging young people from groups underrepresented in the engineering and technology field.

ABOUT THIS REPORT

Over the past 3 years, EQ has been evaluated drawing on findings from surveys with students and teachers completed after participating in the workshop. This evaluation aimed to understand experiences of EQ, the effectiveness of yearly content iterations and the workshop's perceived impact on students' knowledge, attitudes, and aspirations.

In the 2022/23 school year, following a successful pilot of a new pre and post evaluation approach in the second year of the programme, we recruited a select group of schools to take part in this evaluation. As part of this pre and post approach, students were asked to complete a survey before taking part in EQ to measure their existing knowledge and attitudes towards engineering. They were then asked to fill in a second survey at the end of the workshop to capture any changes and gain a better understanding of the impact of EQ.

This report focuses on the findings from the third-year pre and post evaluation, concentrating specifically on the change in key measures resulting from student participation in the workshop. A more complete analysis of the programme reach, school experiences, student's view on the impact of the workshop and feedback for improvement can be found in the full evaluation report.

Out of 7 schools recruited, 5 successfully completed both the pre and post surveys. We collected a total of 102 matched student responses, ranging from 4 to 39 per school. In an effort to boost participation, we offered schools the option to receive paper copies of the student surveys or to use online survey links.

In addition to presenting our findings from the pre and post data analysis, this report offers insights into considerations for future data collection processes.

KEY FINDINGS

As a one-off workshop, we didn't anticipate a significant change in student views or attitudes related to engineering and technology careers. The slight shifts we observed, particularly in terms of knowledge, indicate positive short-term changes. These findings suggest that Energy Quest has the potential to be a helpful step within multiple STEM engagements that together enable young people to gain the capability, motivation, and participate in opportunities towards pursuing careers in these sectors.

Based on the evaluation of a modest sample of 102 students engaged in the pre and post surveys, our analysis reveals the following key findings:

- EQ does improve students' knowledge of various engineering roles
- We found a small but not significant increase in the number of students agreeing they know about engineers' roles in creating green technologies
- While there was a small increase in student agreeing that learning about science will be useful for their future job, this shift was not significant
- EQ doesn't currently appear to change students' interest in an engineering, science or technology related career. It also doesn't shift students' belief in whether they could become an engineer
- We found a small but not significant increase students viewing engineering careers as more desirable

The findings presented in this pre and post evaluation report should be considered alongside the full evaluation report.

About the pre and post evaluation

Evaluation approach

The aim of adopting a pre and post approach is to establish a more robust measure of change compared to collecting data only after the workshop, acknowledging that students are at different starting points when participating in the EQ workshops. This report focuses on analysing the extent to which students' knowledge, attitudes and aspirations changed following their participation in EQ.

Initially, our primary goal was to assess the differences in student outcomes between a two types of the content 3 workshop: one focused only on hands-on STEM activities, compared to another one with reduced hands-on activities but featuring a career-specific component. However, challenges in determining the specific workshop type well in advance led to difficulties in timely school recruitment and material dissemination. Consequently, we revised our approach in spring 2023. This adjustment was crucial to accommodate the logistics of teacher preparation and student survey completion before their involvement in an EQ workshop. It's worth noting that this evaluation mirrors the approach taken in the pre and post pilot conducted in 2022.

Presentation of findings

This evaluation is based on student surveys with key questions that in most cases follow a Likert scale structure, meaning young people had the option to give a response on a 5-point scale with a strong negative on one end and a strong positive on the other. The questions also included a 'don't know' response option, which has been excluded for the purpose of our analysis.

To make sense of the data, we provide 3 ways of comparing the pre workshop and post workshop responses[1]. This helps us get a better understanding of any shift on the measures of interest between the 2 time points.

The odds of giving a positive response

Since to achieve our desired impact of more young people pursuing engineering and technology careers, students need to have positive attitudes towards STEM and positive STEM career aspirations, we first looked at the data using a binary approach. This means we analysed students' positive responses (e.g. very interested or quite interested) after the workshop compared to before. We did this by comparing these positive responses to each question with negative or neutral ones (e.g. not at all interested, not interested or neither interested nor uninterested).

We then calculated the odds of students giving a positive response to understand whether there is a link between their responses and their participation in the workshop.

Positive or negative movement

To conduct the remaining analysis, we coded the response options to the survey questions on a scale from 1 to 5:

- Strongly disagree /Not at all interested / Not at all desirable (coded as 1)
- Disagree / Not interested / Not desirable (2)
- Neither agree nor disagree / Neither interested nor uninterested / Neither (3)
- Agree / Interested / Desirable (4)
- Strongly agree / Very interested / Very desirable (5)

Individual scores were then compared before and after the workshop. As a student could be starting from any position on the scale, comparing scores helps us understand whether participants are moving towards a more positive response or a more negative response, and the distance of this movement. This is important to evaluate as the workshop may be moving some students closer towards considering a future in STEM as well as further away from it.

Comparing mean scores

Finally, to measure whether there has been any change across the response scale, we calculated and compared the average (mean) coded responses for each key measure given before and after the workshop. This analysis enables us to see whether there is a genuine shift along the scale as a whole.

Evaluation sample

The numbers of students in this pre and post evaluation are fairly modest, but it still provides valuable insights. A larger data set would enable us to capture small yet genuine changes and to avoid any unintentional biases.

Furthermore, the findings presented in this report are based on a small group of schools involved in EQ in 2022/23. It's important to note that we can't be highly certain that the same patterns would be observed in the other schools that participated in EQ.

1 Please note that significance testing has been used to look for statistical differences in responses. In our analyses, odds ratio and t-tests have been used. Where there is a significant difference between variables, that is based on a 95% confidence level. All differences noted in this report are statistically significant, unless otherwise stated.

STUDENT EVALUATION PARTICIPATION

- **5 of the 7 EQ** schools who were recruited for this evaluation provided both pre and post student survey responses.
- **All schools involved in this evaluation were EngineeringUK priority schools**, meaning they met our equity, diversity and inclusion criteria.[2]
- **All schools delivered content 3 workshop**
- **Over 200 survey responses were collected for both pre and post surveys. Out of these a total of 102 students** completed surveys both before and after the workshop. Their responses to each survey were matched using a unique identifying code.

How was data collected?

Teachers were incentivised to support the pre and post evaluation approach in their school. They were asked to make time during the school day for students to complete a survey prior to taking part in EQ. Students were then asked to fill in a second survey at the end of the workshop to capture any change in their knowledge, attitudes or aspirations towards engineering. This year teachers had the option to either request paper copies of the surveys or use online links for students to complete.

How engaged in STEM were participants?

As part of our evaluation, we asked young people questions to explore their pre-existing levels of engagement in STEM outside of school. For our analysis, we gave students a STEM engagement score based on how many of the types of STEM activities listed they do outside of school: low (none of STEM activities we asked about), medium (1 to 2 activities), or high (3 or more activities) [3].

When interpreting the findings presented in this report, it's worth noting that about half of the students who took part in this evaluation reported engaging in 3 or more STEM related activities outside of school. While 35% of young people reported not knowing anyone who works in a STEM related career, most respondents said they knew a parent or guardian, a family friend or another STEM professional (64%).

Their pre-existing level of interest, experience or exposure of STEM may be a factor in the limited or no change in some of the measures presented in the following section.

Young people who completed both surveys

	No.	%
Total	**102**	
Year group		
Year 7	32	31%
Year 8	53	52%
Year 9	17	17%
Gender		
Female	39	38%
Male	61	60%
Non-binary or other self-description	1	1%
I don't want to answer	1	1%
Ethnicity		
Asian/Asian British	32	31%
Black/Black British	26	25%
Multiple ethnic groups	6	6%
White	26	25%
Other ethnic identity	6	6%
I don't want to answer	6	6%
Free school meals		
Yes	20	20%
No	67	66%
I don't know	14	14%
Missing	1	1%
Disabilities		
Yes	7	10%
No	76	73%
I don't know	14	11%
I don't want to answer	5	4%
STEM engagement		
High	49	49%
Medium	35	35%
Low	16	16%

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).
3. Our measure of STEM engagement is based on the survey question: 'Do you do any of the following science related activities outside of school?'. Respondents could choose from the following options: 'Watch science programmes on TV or online (e.g. YouTube)'; 'Visit science museums or displays'; 'Read science books (including science fiction)'; 'Read about science on the internet'; 'Attend a science, technology, engineering or maths club'; 'Create my own computer games, website or animation'; 'Go to a science or engineering fair'; 'Listen to a podcast or ratio programme about science'; 'None of the above'. Question wording and options were adapted from the science capital index.

Findings on the impact of EQ

KNOWLEDGE OF ENGINEERING CAREERS

EQ aims to increase students' knowledge about the types of things that people who work in engineering roles do. Half or participating students (50%) already agreed that they know of the types of things engineers do before taking part in EQ. Following the workshop, this increased to 66%, with more than double the proportion who strongly agreed with this statement.

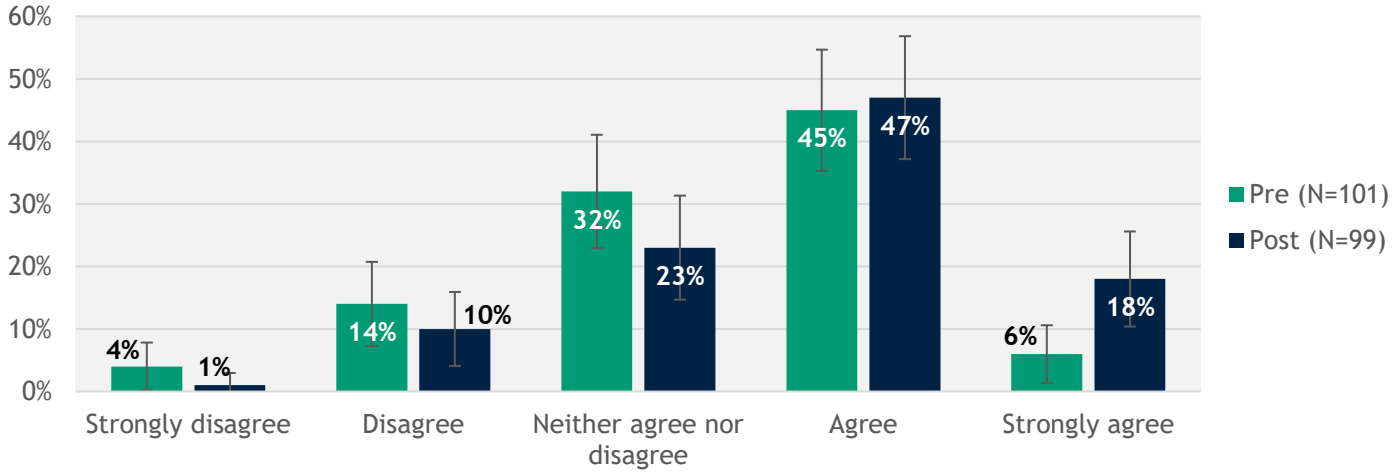
Comparing individual response scores, we found that 43% of students gave a higher knowledge rating after the workshop, compared to before, and 16% indicated a lower rating. The remainder (40%) of respondents reported no change in their score.

Knowledge related measures provide valuable insights, yet they have limitations. They don't fully capture all changes in learning, particularly for those already familiar with the topic. For instance, this question cannot tell us how many students discovered that what they thought they knew about engineering changed after the workshop, and it doesn't consider increased knowledge among those who already strongly agreed.

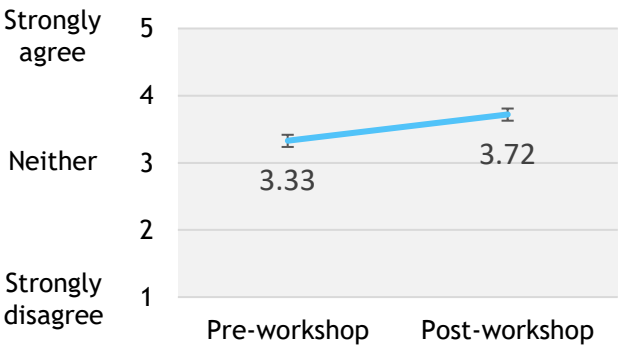
KEY FINDINGS

- **After the workshop, students were more likely to agree that they know about the types of things engineers do in their jobs, compared to their response beforehand** [4]
- **The average score for students reporting they know about the different types of things that engineers can do in their jobs increased slightly from 3.3 to 3.7**
- **Overall, our analyses suggest that EQ does have a small but real effect on students' reported gain in knowledge of the range of engineering roles**

"In general, I know about the different types of things that engineers can do in their jobs"



Mean scores before and after the workshop



To assess whether the change across the full range of responses was statistically significant, the Likert scale was coded from 1 (strongly disagree) to 5 (strongly agree) and we compared the mean scores before and after the workshop.

Our analysis found that after the workshop, the mean scores increased slightly (from 3.3 to 3.7), and this change was significant.[5] It indicates that EQ has a small but real effect on what students know about the various things that engineers do.

4. Odds ratio: students responding 'Agree' / 'Strongly agree' vs all other responses (OR = 1.87 95%CI [1.06-3.31])
5. Paired sample t-test: $t(99)=-3.912$; $p<0.05$

KNOWLEDGE OF ENGINEERS' ROLE IN CREATING GREEN TECHNOLOGIES

The workshop specifically aims to increase students' knowledge of engineers' roles in developing greener technologies.

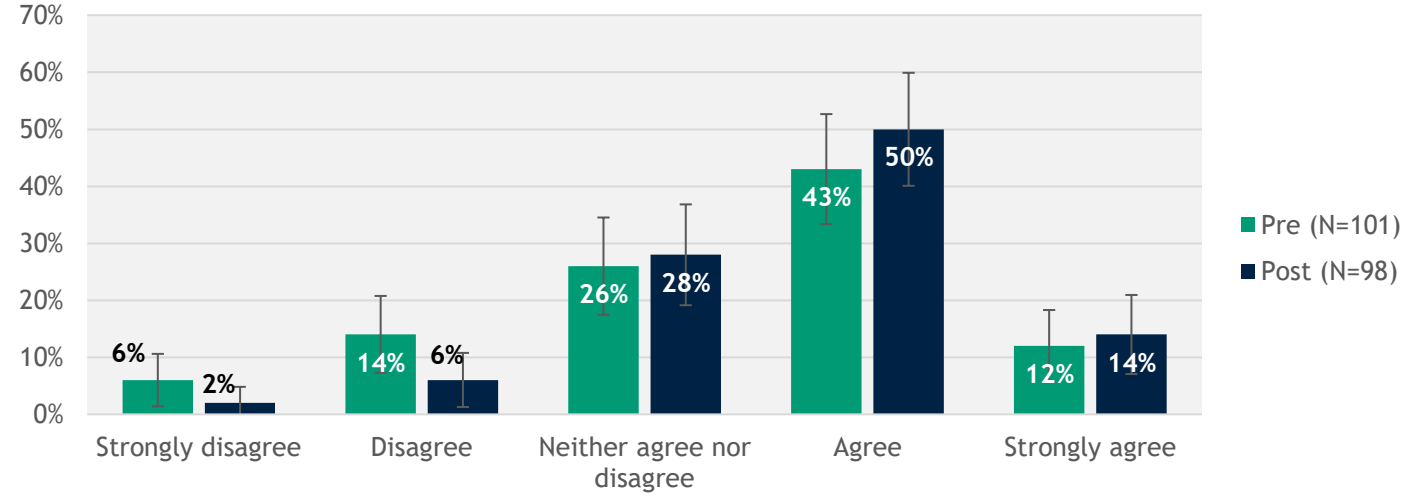
Before the workshop, just over half of students (54%) already agreed they know about the roles engineers play in creating green technologies. This increased to 64% following the workshop. There was a slight shift towards students agreeing, from 43% before the workshop to 50% afterwards. At the other end, there was a decrease in those who disagreed, from 14% to 6%.

Comparing individual scores, 44% of students did not change their response to this question after the workshop. 36% of students reported an increase in knowledge, and 20% indicated it as lower.

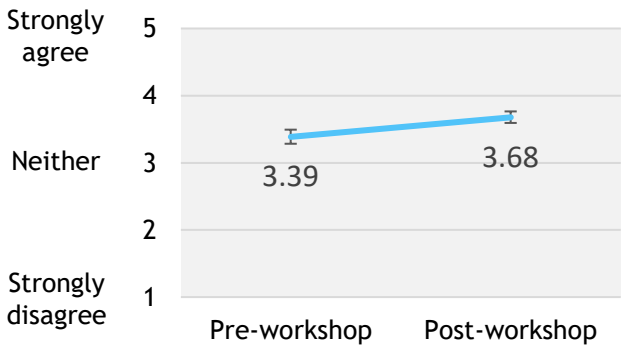
KEY FINDINGS

- **After the workshop, students were no more likely to agree that they know about the role engineers play in developing green technologies**
- **The average score for students agreeing with the statement increased slightly from 3.4 to 3.7**
- **Our analyses show that although more students reported knowing about engineers' roles in green technologies, the workshop isn't significantly changing the number of students moving from disagreeing or giving neutral responses to agreeing they know about this topic**

"I know about the role engineers play in developing technologies for renewable energy sources"



Mean scores before and after the workshop



When comparing mean scores, we found a slight but significant increase after the workshop compared to before [6]. The mean score before the workshop was 3.4 and 3.7 after the workshop.

This indicates that EQ has a small but real effect on what students know about the role engineers play in developing technologies for renewable energy sources.

6. Paired sample t-test: $t(98)=-2.969$; $p<0.05$

ATTITUDES ON THE FUTURE USE OF SCIENCE

In 2022/23 a new measure was included in the student survey with the aim to capture any change in young peoples' perceptions on the usefulness of science for their future careers.

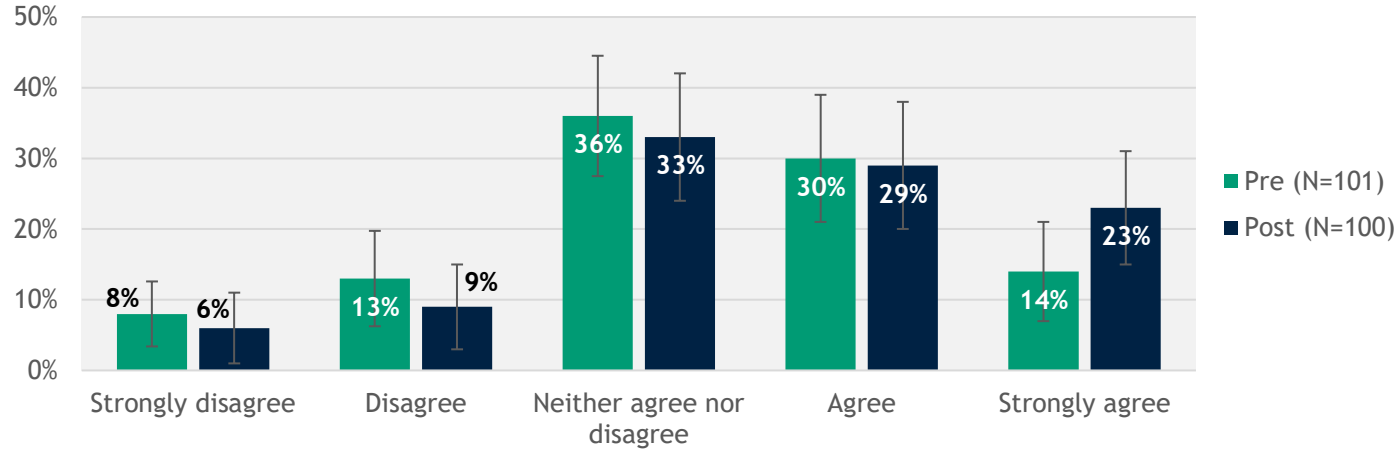
Before the workshop, 44% of students already agreed that learning about science will be helpful for their future job. There is a small increase following the workshop to 52%, with a shift towards more strongly agreeing with the statement (23% after, compared with 14% before).

Comparing individual scores, half of students (51%) reported no change in their response to this question. 33% of students reported a higher score on the usefulness of science, and 16% indicated a lower score.

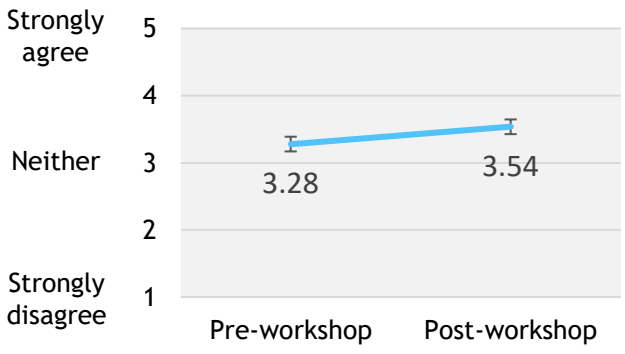
KEY FINDINGS

- **After the workshop, students were no more likely to agree that learning about science will be helpful for their future job**
- **The average score for students agreeing science will be useful in their future careers increased slightly from 3.3 to 3.5**
- **Our analyses show that although more students view science as useful for future careers, the workshop isn't significantly changing the number of students moving from disagreeing or giving neutral responses to agreeing with this statement**

"Learning about science will be helpful for my future job"



Mean scores before and after the workshop



When comparing mean scores, we found a slight but meaningful increase after the workshop compared to before. The mean score before the workshop was 3.3 and 3.5 after the workshop.

This indicates that EQ has a small but real effect on students' attitudes towards the usefulness of science for their future career.

3. Paired sample t-test: $t(100)=-2.276$; $p<0.05$

INTEREST IN AN ENGINEERING CAREER

Students were asked about their interest in science, engineering or technology careers both before and after the workshop. Overall, we found that students were no more likely to say they are interested in a career in these fields after the workshop, compared to before taking part. For the purpose of this report, only findings related to interest in engineering are presented below.

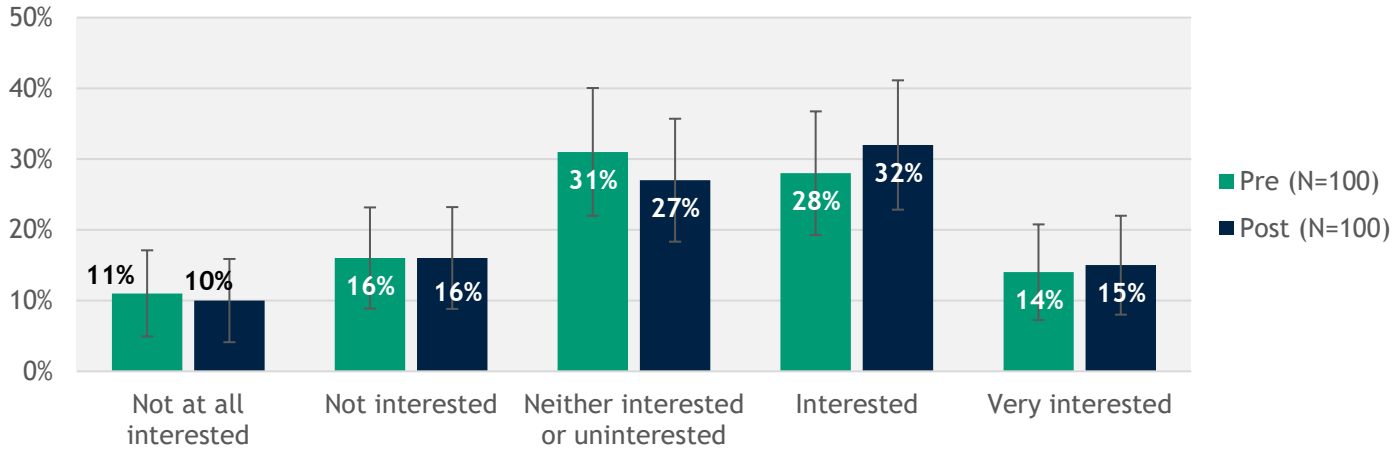
Prior to the workshop, 42% of students said they were interested in a career that involves engineering. Following the workshop this proportion increased slightly to 47%, but with a small shift from a neutral response more towards students reporting they are interested in an engineering career (after the workshop 32% reported being interested, compared with 28% before).

Comparing individual scores, 47% of students reported no change in their response to this question. 30% of students reported a higher score on interest in an engineering related career, and 23% indicated a lower score.

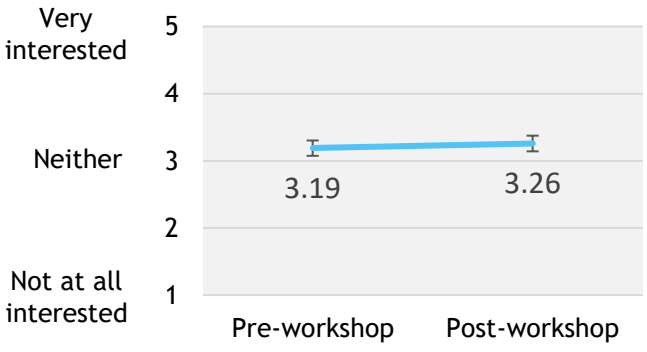
KEY FINDINGS

- **After the workshop, students were no more likely to say they are interested in a career that involves engineering, science or technology**
- **The average score for students interested in a career in either of these 3 areas did not significantly increase**
- **Our analyses suggests that EQ does not currently change students' interest in an engineering, science or technology related career**

"How interested are you in a future career that involves engineering?"



Mean scores before and after the workshop



When comparing mean scores, we found no significant increase after the workshop compared to before. The mean score on interest in engineering before the workshop was 3.2 and after the workshop this was 3.3.

DESIRABILITY OF ENGINEERING CAREERS

Students were asked about whether an engineering career is desirable, helping us understand positive attitudes towards engineering in general.

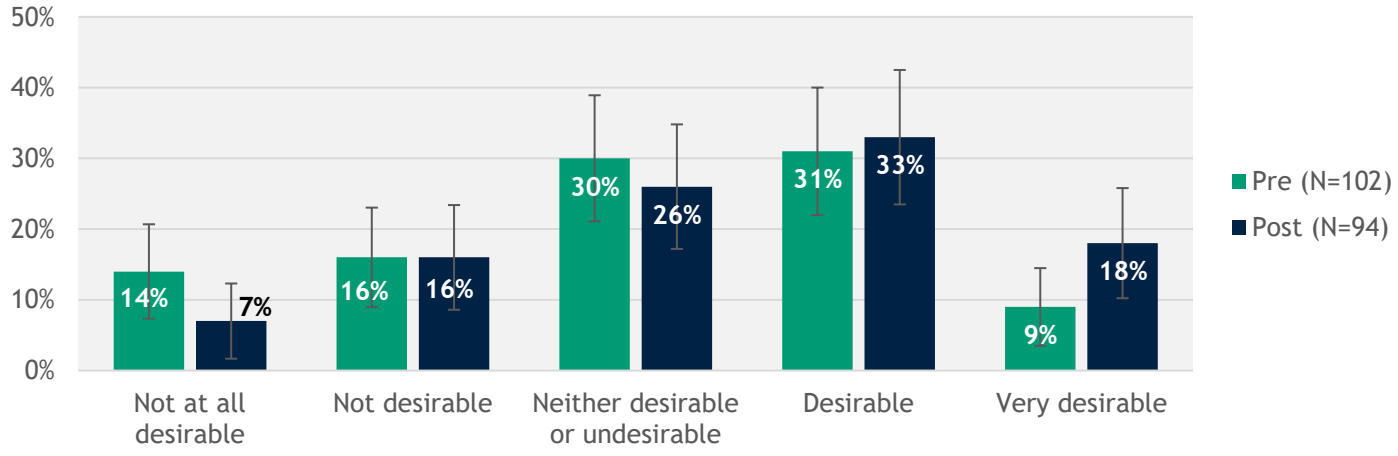
Before the workshop, 40% of students said they believed a career in engineering to be desirable. Following the workshop this proportion increased to 51%, with double the number of students believing engineering careers to be very desirable.

Comparing individual scores, 40% of students reported no change in their response to this question. 44% of students reported a higher score on desirability of an engineering related career, and 16% indicated a lower score.

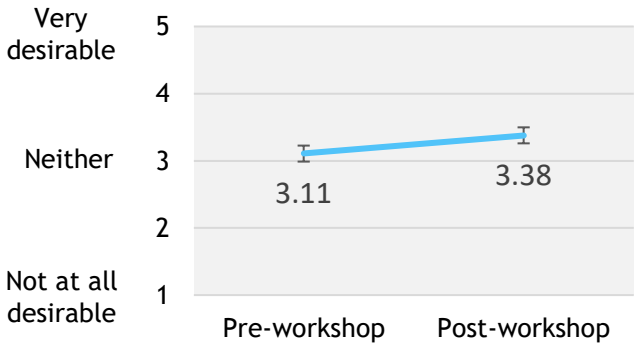
KEY FINDINGS

- **After the workshop, students were no more likely to say that engineering is a desirable career for them**
- **The average score for desirability of an engineering career increased slightly from 3.1 to 3.4**
- **Our analyses show that although a higher number of students view engineering careers as desirable, the workshop isn't significantly changing the number of students moving from giving negative or neutral responses to positive ones**

"How desirable do you believe a career in engineering to be?"



Mean scores before and after the workshop



When comparing mean scores, we found a slight but meaningful increase on this measure after the workshop compared to before. The mean score before the workshop was 3.1 and 3.4 after the workshop.

This indicates that EQ has a small but real effect on students' attitudes towards whether engineering careers are desirable.

ABILITY TO BECOME AN ENGINEER

Students were asked about whether they thought they could become engineers if they wanted to. Before the workshop, 59% of students said they believed that they could become an engineer if they wanted to. Following the workshop, this has only slightly decreased to 57%.

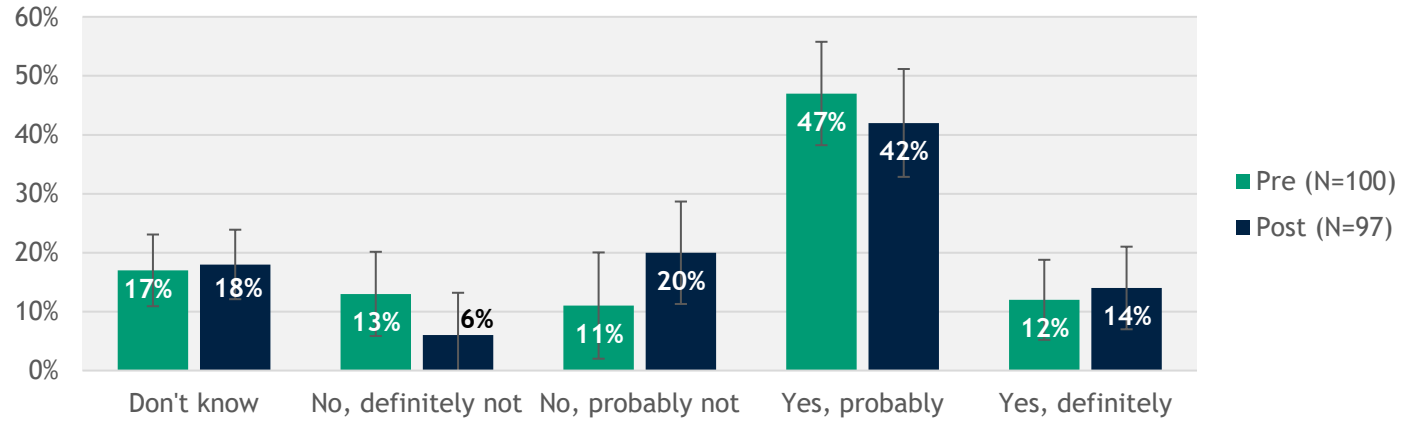
Comparing individual scores, nearly three quarters (74%) of students reported no change in their response to this question. 17% of students reported a higher score on their ability to become an engineer, and 9% indicated a lower score.

We asked students who did not think they could become an engineer to share the reasons for their response. Half of these students (17 out of 34) said it was because they are not good enough at science, some shared they are not good enough at maths (15 out of 34 students), while 12 said they didn't know enough about how people become engineers.

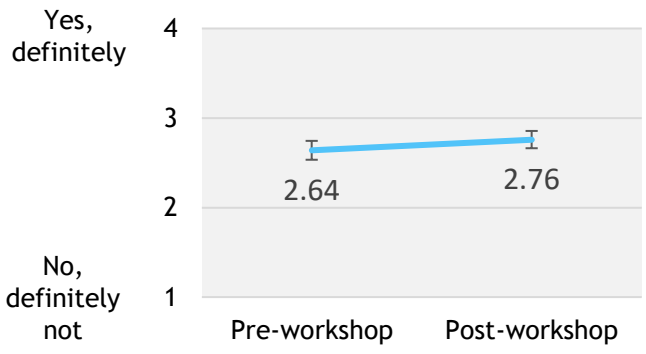
KEY FINDINGS

- **After the workshop, students were no more likely to say they could become an engineer if they chose to.**
- **The average score for students' belief in their ability to become an engineer did not increase significantly**
- **Our analyses show that EQ does not currently change students' belief in whether they could become an engineer**

"If you wanted to, do you think you could become an engineer?"



Mean scores before and after the workshop



When comparing mean scores, we found no significant increase after the workshop compared to before. The mean score on belief in ability to becoming an engineer before the workshop was 2.6 and after the workshop this was 2.8.

Conclusions and learning

CONCLUSIONS AND LEARNING

This companion report aims to highlight shifts in students' self-reported knowledge, attitudes or aspirations following participation in Energy Quest. Our findings indicate that while certain measures show positive changes, others do not, presenting an overall mixed picture. Given that Energy Quest is a one-off, short intervention, significant shifts in attitudes or aspirations were not necessarily expected. However, seeing the small movements in some measures does suggest positive short-term outcomes from the workshop. These findings indicate that the workshop has the potential to be a helpful step in a broader STEM engagement context that contributes to the cultivation of sustained interest in engineering and technology careers among young people.

EQ does increase young people's knowledge about engineering careers in general

Supporting young people to gain knowledge about engineering careers is key for inspiring interest and fostering confidence in pursuing such careers. Our findings show that there is an increase in young people's knowledge about the different types of things that engineers can do. Even though this is not an objective measure of knowledge, it does indicate that young people feel they know about engineering careers and these being potential options, regardless of whether they choose to pursue engineering or not.

Though more students reported knowing about engineers' roles in creating green technologies, EQ is not leading enough students to move from disagreeing or giving a neutral response to agreeing they know about this topic. This may be an area that needs to be addressed in future iterations of the workshop content. It may be necessary to make more explicit the link between workshop activities and the roles engineers have in developing technologies for renewable energy sources.

Though more students view science as useful for their future job, the workshop is not shifting students' views from disagreement or uncertainty to agreement on this matter

This was a new measure introduced in this year's pre and post evaluation to capture any change on young people's views of the usefulness of science. We see a small but positive movement across the response scale. However, the workshop is currently not converting enough students to move towards agreeing that science is useful for their future job. This could be not only linked to the workshop per se, but also dependent on the extent to which young people already have a sense of their future career.

EQ does not currently increase young people's Interest in an engineering career

While acquiring knowledge about engineering careers is key, this alone is not sufficient to steer many students toward a STEM career path at this stage in their life. Although there is some movement across the scale, our findings suggest that the workshop is not significantly changing students' interest in a career in engineering, science or technology. This means it is not converting students from being uninterested or giving a neutral response to being interested in STEM careers. However, this may be due to various factors. At the age of 11 to 14, young people may view it as premature to already consider their future careers or may have pre-existing interests in non-STEM related fields, even if they find EQ enjoyable.

Interestingly, there is a shift in students' responses to whether engineering is a desirable career, but this does not amount to a significant increase in the odds of agreeing that engineering is desirable.

EQ does not currently increase young people's belief in their capability to become an engineer

Our analyses suggests that the workshop does not currently change students' belief in whether they could become an engineer, with nearly three quarters of students reporting no change in their response and a high proportion of students already thinking they could become an engineer (59%) before the workshop.

These findings suggest that EQ is most effective at raising awareness of the possibilities for careers in engineering. However, the workshop alone may not be as effective in creating a commitment to pursuing an engineering career for young people. Consistent with broader evidence, these findings support the need for multiple STEM outreach initiatives to gradually foster young people's interest and careers aspirations throughout their educational pathways.

It's promising that there's a positive shift in some measures, given the brief nature of the 2-hour workshop. However, both these findings and those from the previous pre and post evaluation conducted in 2021/22 suggest that the workshop, by itself, is currently insufficient to bring students to a consistently positive view on pursuing STEM careers.

This also aligns with broader evidence supporting the necessity of employing multiple STEM outreach initiatives that progressively nurture students' interest over time. EQ emerges as a valuable step in making engineering careers a possibility, but additional efforts may be required to transform knowledge of these careers into genuine aspiration.

This report should be viewed in conjunction with the findings from the comprehensive evaluation report based on post-workshop surveys as it includes a larger sample of students. That report delves into student experiences of EQ and their perceived impact of the workshop.

Learning for evaluation

Conducting a pre and post evaluation is needed to begin to measure the change in students' views before and after EQ. Given the short time between the 2 time points when data was collected, it is possible that the change reported here is the result of the workshop itself rather than a more general trend.

Sample

The number of students in this evaluation are modest but allow for meaningful analysis. Due to the small sample sizes among pre and post evaluation participants, no analysis is provided by different student characteristics.

This year a paper-based approach for data collection was trialled with teachers. Our aim was to improve our survey response rates. While the overall number of matched responses is smaller than last year, we did receive a higher number of responses among schools who chose to receive paper surveys. Giving schools the option to choose the easiest method for data collection could be an approach to consider for future evaluations.

Sustainability

Collecting data at 2 time points presents an added workload for busy teachers. Limited access to devices for student surveys and difficulty in scheduling the evaluation alongside school activities can be challenging. Understandably, many schools we approached were not able to complete this request. To boost participation, we offered schools a £250 incentive upon completing data collection and offered the option to complete paper-based versions of the surveys. Despite these adaptations, recruitment remained a time-intensive aspect of our evaluation approach.

We also faced challenges in determining which of the two types of workshop for content 3 schools would be taking part in with enough advance notice to plan evaluation logistics. For future pre and post evaluations, we will continue to work closely with the programme team and streamline the process of determining the type of delivery, especially in cases where multiple stakeholders are involved in a programme delivery. Continuous monitoring and adaptation throughout the process will be crucial and early engagement with schools and stakeholders can help anticipate any potential challenges. We will continue to conduct pre and post evaluations and look at how a larger sample could be achieved through additional practical support for schools.