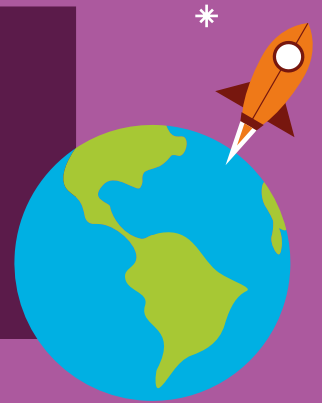# Inspiring the **next generation** of engineers

Understanding the perceptions of engineering that parents and young people have today and how we can change them.

Welcome

At the IET, we're working to engineer a better world by inspiring the next generation of engineers and technicians. Our activities to engage young people include awards schemes, education initiatives and collaborating with partners such as Tomorrow's Engineers and the Government's 'Engineering: Take a Closer Look' campaign.

We strongly believe that a career in engineering and technology offers a combination of creativity, excitement, challenge and financial reward that few other careers can match. But we still face the challenge of making children and their influencers, such as parents and teachers, aware of this.

This year we built on research previously conducted in 2015 to take a fresh look at how children, their parents and teachers see engineering and technology. We wanted to identify if perceptions have changed, what factors are still getting in the way of children considering careers in engineering and technology and how we can overcome these barriers.

Since 2015, perceptions of engineering and technology have improved, with both children and parents less likely to describe engineering jobs as 'messy and dirty'. Children in 2019 are more likely to describe engineering as 'modern, professional and interesting', while parents are more likely to say that it 'makes a difference'. It's a move in the right direction, but there is still work to be done.

More than one in five parents felt that if their child came to them asking for advice on engineering and technology careers, they wouldn't know enough to help. Parents of girls typically felt less confident in helping.

Providing a little more information can make all the difference. When we showed our focus groups further career information, three in four parents agreed they would like to know more, as the majority had no idea about the variety of jobs available, or that creativity and art were involved.

For the first time, our research included teachers and many expressed a desire for resources that would help them engage children in STEM (Science, Technology, Engineering and Maths) subjects. While primary school teachers were keen to use resources for practical activities, secondary school teachers were more interested in vocational activities such as employer visits and college taster days.

With perceptions of engineering and technology improving, and an appetite by influencers to support and engage children with STEM and their future careers, now is the time to really increase our efforts. We need to send out clear messages to parents and children about the variety of creative and fascinating careers in engineering and technology. We hope you'll join us in inspiring the next generation of engineers and technicians.

Nigel Fine BSc MBA CEng FICE FIET
Chief Executive

Introduction

Despite progress since the IET's Engineer a Better World campaign launched in 2015, there is still work that needs to be done to inform parents and children about what modern engineering is and the range of opportunities that a career in this industry encompasses.

Since we last carried out this research in 2015, perceptions of engineering have improved and adding 'technology' to the phrasing of key questions has lifted expectations. But knowledge and understanding of the industry is still lacking and varies depending on experiences.

When presented with a wide range of modern engineering careers, children and their parents are impressed by the breadth of options, especially the emphasis on creativity, which makes the idea of a career in this industry a lot more attractive.

Raise the profile of modern engineering

Schools need to engage children from an early age, with fun and practical activities that fuel their imagination and introduce them to the term 'engineering'. Activities should also help children to appreciate the impact engineering has on their daily lives, in areas where they show interest such as gaming and sports. With work-life balance of increasing importance, activities should explore the lifestyle of a modern-day engineer so that children can see what it might be like for them and look beyond any dated misconceptions.

Parents need to understand the skills that a child would need to pursue a career in modern day engineering, as they often think about engineering in narrow terms.

Build awareness of the diversity of engineering careers

Few children (or parents) appreciate the range of engineering career options, until they are put in front of them. They need to learn about the breadth of engineering opportunities, before they exclude them by default. It comes as a big surprise to many that engineering involves creativity and art. This increases interest among children, especially girls, and reinforces the message that engineering is a modern and progressive industry.

We need to highlight environmental roles in engineering, as these are likely to become more important over the next few years, with interest in this area growing steadily. Having the opportunity to make a difference is something that appeals to girls in particular.

Engage children more in STEM subjects, especially girls

The number of children who say they enjoy STEM subjects has fallen since 2015, with only Maths maintaining its position as their favourite subject. A lack of enjoyment among boys is fuelling the decline in ICT / Computing and Science, but the number of girls enjoying these subjects has also dropped. This pattern, along with fewer children enjoying 'gadgets and new technology' suggests that technology is becoming normalised, with children less likely to see it as exciting and different.

Children dislike STEM subjects because they find them 'boring' and 'too hard'. Girls are more self-critical than boys, often requiring more reassurance and encouragement, and favouring subjects that they know they're good at. It is important that teachers recognise these differences and that they vary their lesson plans, and the way they recognise progress, to suit girls and boys.

Role models are also important. Girls need to see people like them in STEM careers, so that they can relate and aspire to something similar.

Engaging BAME parents and children

Overall, perceptions of engineering and technology among BAME (Black, Asian and Minority Ethnic), parents are very good. Technology is the industry that they think their child would be most interested in, and they are more likely than other parents to rate engineering as a potential career for their child. They see the engineering industry as professional and modern, but they are more surprised than other groups to see that creativity and art are involved in these career areas. There could be a risk that promoting this aspect too heavily among this group could damage its appeal, especially given that they are more likely to rate traditional industries such as healthcare and finance.

BAME parents and children are also less likely to agree that any of the suggested initiatives (e.g. school trips, visits etc.) would help to promote engineering and technology. Children are more likely to choose options that allow them to showcase their talents, including an engineering / technology club and competitions.
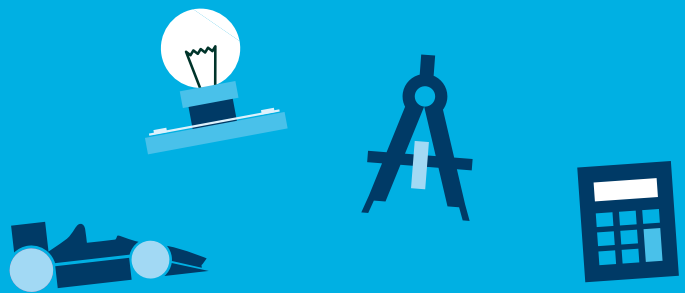
About the research

The IET commissioned CHILDWISE to explore what factors inform parents' and children's opinions of engineering and technology as potential career areas. The research also looked at what might be preventing parents from more actively promoting these careers, and what might encourage them to do so.

Building on research in 2015, it was conducted across April to June 2019, with boys and girls aged six to 15, their parents, and STEM teachers of children this age. This consisted of in-depth interviews across England, involving 16 children, 15 parents, and six teachers, followed by an online survey, with over 1,000 children and their parents, and almost 150 STEM teachers.

Research Findings
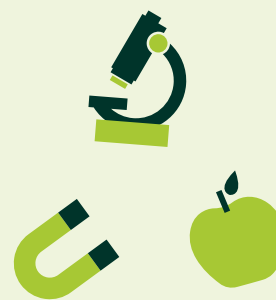
Children:

Children nowadays have a wide and ever-expanding range of potential career paths available to them, meaning that engineering especially, has far more competition than it had in the past.
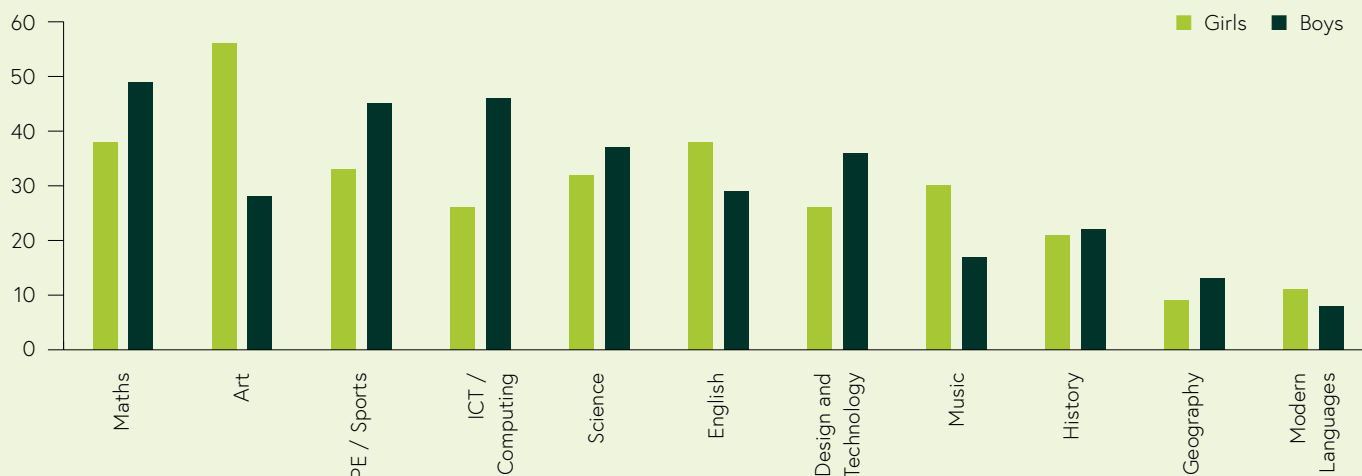
Parents say that their children have at least some of the core skills and talents required for a career in engineering, so fostering an interest from an early age is key, both at home and at school.

Children and STEM subjects

Which subjects do children enjoy most at school?

When asked what subjects they enjoy at school, Maths tops the list overall – with more than two in five children naming it as their favourite. The remaining STEM subjects are chosen by around a third of children aged 6-15.

STEM subjects are enjoyed far less by girls - girls enjoy Art (56%) and English (38%) more than any of the STEM subjects, whereas Maths and ICT / Computing are the two top choices among boys. Among the STEM subjects, Maths is the girls' favourite (38%), followed by Science (32%).

Compared to 2015 - In 2015 STEM subjects topped the table among 9-12 year olds, but four years later only Maths has maintained its position among boys and girls. The remaining STEM subjects have dropped down the table, with ICT / Computing and Design and Technology falling furthest (both are down 12-14%), and Science also trailing behind (down 10%).

A lack of enjoyment among the boys is fuelling the decline for ICT / Computing and Science, although the number of girls enjoying these subjects has also dropped. Enjoyment of Design and Technology has dropped more equally among girls and boys.

What is it children like about STEM subjects?

Children like STEM subjects because they involve using computers and other equipment, they enjoy making things, problem solving, and finding out how things work.

Only a small proportion didn't like any STEM subjects and this was mainly as they found them 'boring' or 'too hard'.

working science learn designing easy finding
creative numbers different computers experiments playing
subjects subject make love adding creating computer right
working challenging find enjoy coding class solve
problems interesting work learning design sums
games solving good making computer exciting
logical fun think brain answer
new maths practical know everything school problem exciting

Who helps and supports children with STEM subjects?

The vast majority of children have someone to help and support them with STEM subjects - more than half rely on mum for help with Maths and Science, whilst dads and teachers come to the forefront for Design and Technology and ICT / Computing. Design and Technology is the only subject girls are more likely to turn to their dads rather than their mums for. Reliance on parents drops with age, with pre-teens (9-12) beginning to reach out more to teachers, siblings and friends as they get older.

Girls are typically more likely than boys to reach out to their parents and teachers for support, with the only exception being ICT / Computing, when they are more likely to reach out to their siblings.

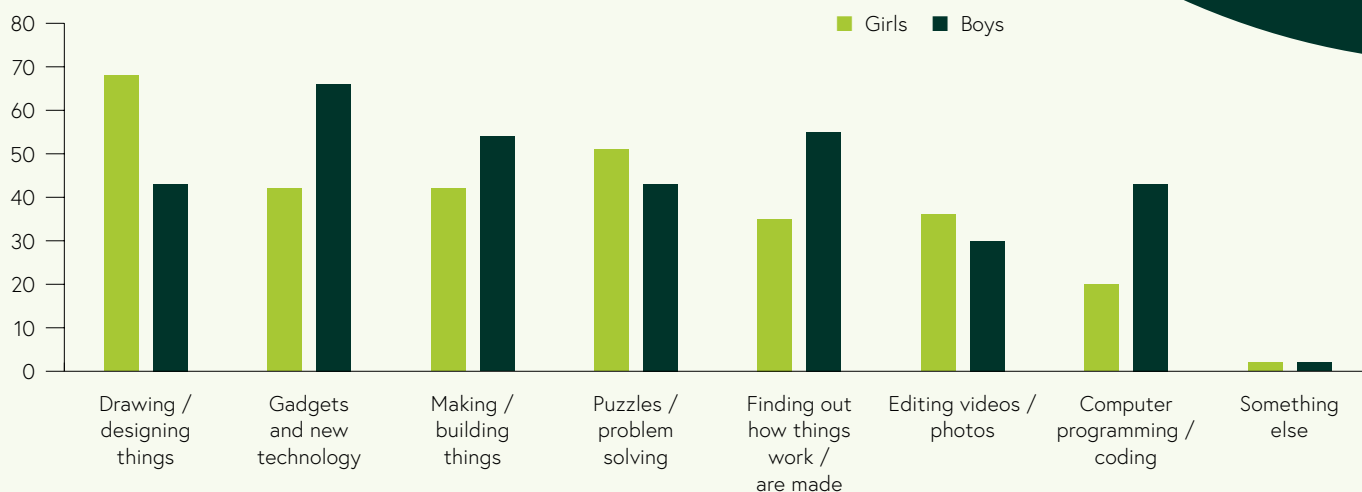# Children's understanding of engineering and technology

More than half of children say they are interested in drawing and designing things as well as gadgets and new technology, but this masks big differences between girls and boys.

Girls are far more interested than boys in drawing and designing things and more interested than boys in puzzles and problem solving, and editing videos and photos.

Boys on the other hand, are much more interested in gadgets and new technology, making and building things, finding out how things work / are made, and computer programming.

Compared to 2015 - Gadgets and technology topped the table among 9-12 year olds in 2015, but this time the number of children this age identifying this as an activity they enjoy has dropped (54%, down from 62% in 2015). This, together with fewer children now saying they enjoy ICT / Computing, suggests that technology has become normalised, with children less likely to see it as exciting and different.

"If we find (the work) confusing or something (the teachers) will normally help us; but if we genuinely don't want to do it they will like motivate us."

Secondary aged girls

What engineering and technology related activities do children enjoy?

Activity	Girls	Boys
Drawing / designing things	68	43
Gadgets and new technology	42	66
Making / building things	42	54
Puzzles / problem solving	51	43
Finding out how things work / are made	35	55
Editing videos / photos	36	30
Computer programming / coding	20	43
Something else	2	2

What is it children like about STEM subjects?

Children predominantly see engineering as making and building things, whilst slightly fewer also talk about fixing things, or about designing things or about engines.

How much do children know about engineering and technology?

Legend:
- Don't know
- Not interested in finding out
- Don't know anything
- A bit
- A lot

Boys claim to know the most about careers in these two industries – including 47% who know a bit, and 7% who know a lot. In comparison, 38% of girls say they know a bit, and 4% say they know a lot.

Girls are more likely than boys to say they don't know anything about careers in engineering and technology and they are also twice as likely to say they're not interested in finding out more.

What do children think engineers do?

Three quarters of children are aware that engineers build things, whilst two thirds believe that they fix things. Slightly fewer think that they design or invent things, with less than half saying that engineers test things.

Overall, boys are more likely to mention a range of skills, suggesting a lower general awareness of engineering amongst girls.

Compared to 2015 – Children aged 9-12 are more likely to mention a range of skills, suggesting a higher general awareness of engineering among this age group.

From the in-depth interviews – On the surface, the word itself (engineering) is still typically seen as being about maintenance and repairs more than anything else – and girls seem to engage slightly less than boys because of this association. But for those who are able to make the connection with STEM, and recognise that engineering is deeply connected with science, technology and maths (subjects that many of them enjoy and find interesting) perceptions are far more positive.

"The inventing thing sounds a bit cool, but the rest doesn't really."

Primary aged girl

"They fix quite a lot of stuff."

Primary aged girl

Children's career aspirations

What sorts of job are children most interested in?
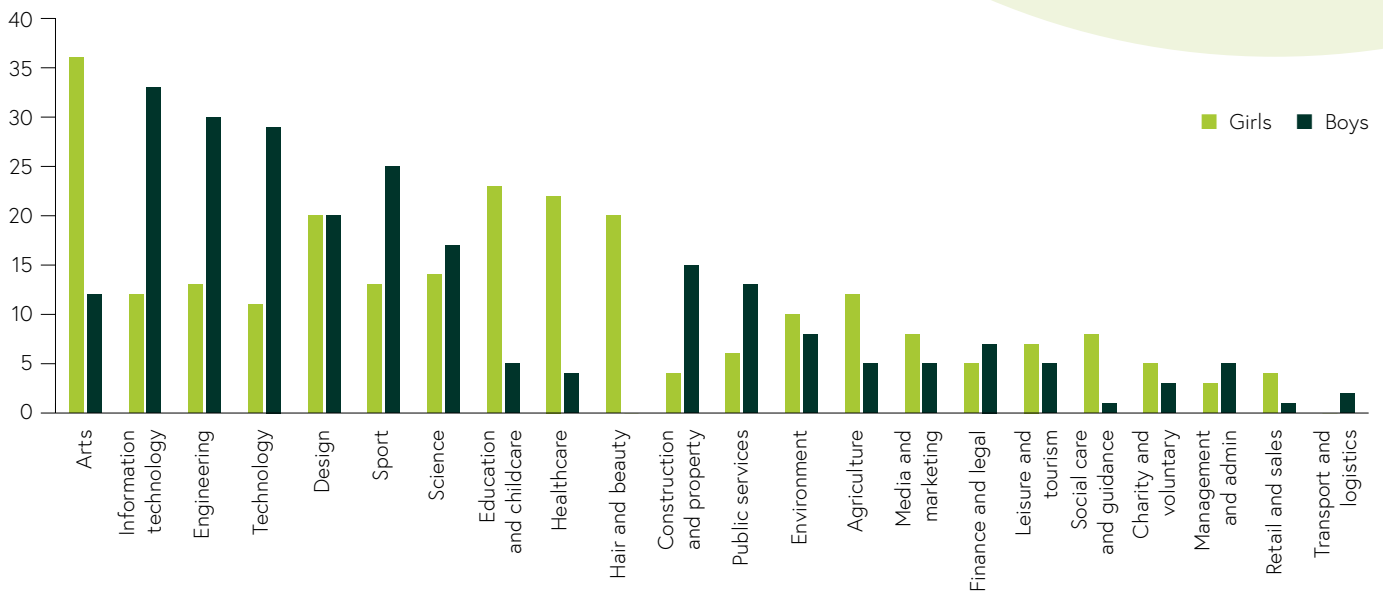
Girls are more interested in the Arts, Education and Childcare, Healthcare, Hair and Beauty and Agriculture (including animal care), whilst boys are much more interested in Information Technology, Engineering, Technology, Sport, Construction and Property and Public Services.

Engineering features in third place, but only one in seven girls themselves would consider an engineering job, whilst technology is in the fourth slot, with only one in nine girls considering a career in this area.

Compared to 2015 - The Arts top the table for 9-12 year olds in 2019 (28%, up from 22%), with the previous top choice, Information Technology, dropping back into second position (23%, down from 29%), in front of Technology, Design and Sport. Engineering now appears in sixth place, up from ninth place in 2015.

From the in-depth interviews – None of the children had given serious thought to what they want to do when they're older. They have ideas, but on the whole, they were openminded about these ideas changing over time and were in no hurry to commit themselves to a specific route.

Children's opinions about jobs in engineering and technology

What words would children use to describe jobs in engineering and technology?

More than half of children describe jobs in engineering as skilled, followed by around two in five who think they are interesting, difficult, creative or important.

In comparison, children are also most likely to describe jobs in technology as skilled, but not to the same extent as engineering. Instead they place more emphasis on technology being modern, as well as describing it as interesting, creative or important.

But, compared to technology, children are much more likely to describe engineering as difficult, or messy / dirty, and much less likely to describe it as modern.

Girls are much more likely than boys to choose negative words to describe engineering, whereas boys are much more positive about it.

Compared to 2015 - Children aged 9-12 are now more likely to describe jobs in engineering as modern, professional and interesting, and they are less likely to describe these jobs as messy / dirty.

Are engineering and technology jobs for both girls and boys?

Children are divided about the engineering industry - only half agree that these jobs are for boys and girls alike, whereas almost as many feel that they are more for boys.

Their response is much clearer when asked about the technology industry - two thirds agree that jobs in this industry are for boys and girls alike, and less than a quarter think they are more for boys.

Girls are typically less convinced than boys that jobs in engineering and technology are for boys and girls, although opinions are much less divided for technology overall.

Compared to 2015 - Children aged 9-12 are now less likely to assume that jobs in engineering are more for boys, and instead, some are more likely to say these jobs are for boys and girls equally, whereas others are undecided either way.

"I went to this thing at (the local) university with one of my friends and we did engineering stuff and that… everyone was like oh this is for boys and girls can't do it; and it was trying to prove the boys and people wrong who were saying that girls can't do it."

Secondary aged girl

From the in-depth interviews – The children gave a resounding 'yes' when asked whether anybody can do any job. But, some of the children (particularly the girls), were quick to sideline the reference to ability, and instead they talked about the importance of having the right mindset – believing in yourself, being determined to succeed, and actually wanting to succeed in your chosen profession. There were several references to having the right 'mindset' throughout the interviews, from girls and from boys.

Would children consider a job in engineering or technology?

- ■ Disagree strongly
- ■ Disagree
- ■ Neither
- ■ Agree
- ■ Agree strongly
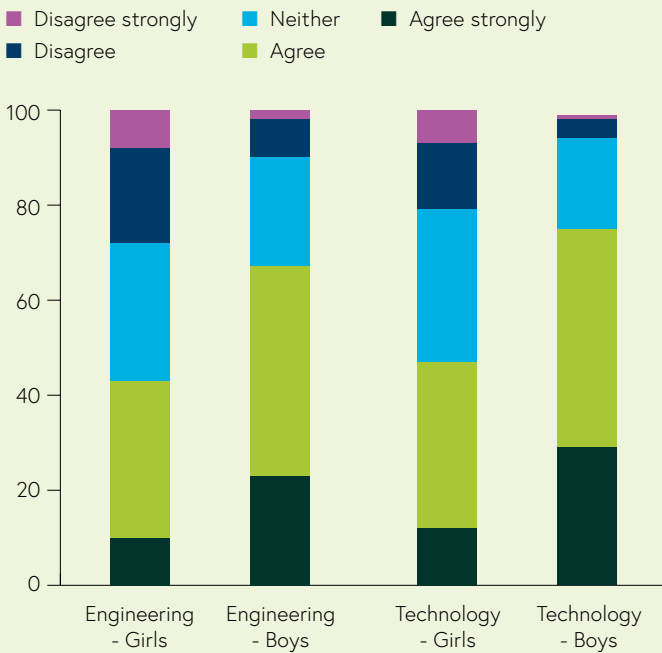
> "I could be pleased (that I'd fixed something), but I wouldn't find it satisfying."
>
> Primary aged girl

Just over half of children would be open to a career in engineering, whereas nearly two thirds of children say they would consider a job in technology. Girls are less likely than boys to consider a job in either engineering or technology.

Compared to 2015 - Even though children are less likely to consider a career in engineering as they get older, they are more positive about the industry than they were previously in 2015. Children aged 9-12 are now more likely to consider a career in engineering, with more than half agreeing that they would consider it.

> "Some people are better at things than others and some people have different skills in different things."
>
> Secondary aged girl

A little information goes a long way

Would children consider a job in engineering or technology, after seeing the sorts of people who work in the industry, and seeing the variety of jobs involved?

Before seeing further information, just over half of children would consider a job in engineering, and three in five would consider one in technology.

After seeing this information, this rises to seven in ten for both engineering and technology, with engineering getting the biggest boost from a little more information.

Girls feel a more positive boost from a little information than boys, although they are still less likely to consider these industries than boys are. Before revealing more information, only two in five girls (43%) would consider a career in engineering, rising to two in three (63%) post-reveal.

For technology, the rise is smaller, but twice as strong for girls than it is for boys. Pre-reveal, fewer than half (47%) of girls would consider a career in this industry, rising to two in three (63%) post-reveal.

Compared to 2015 - In 2015, half of 9-12 year olds would consider a career in engineering (49%), with this rising to seven in ten (71%) after seeing the engineering case studies. In 2019, there has been a general increase in the proportion who would consider an engineering career at all, with more than half (57%) saying they would do this, rising to three in four (74%) after seeing the engineering information.

From the in-depth interviews – When presented with engineering careers, children were impressed by the breadth of options, and they definitely found this engaging – especially the creative aspects. But limited knowledge about the industry means they can still struggle to identify anything truly unique and 'stand-out' about it. The engineering industry needs to establish a clearer identity, one that aligns it to other STEM careers, but also shouts about the features that make it exciting and different.

"That would be fun to design stuff for movies and you would be paid a lot of money with that as well."

Primary aged boy

"I think more people would go for it if it was presented as an arty, crafty thing."

Secondary aged girl

What do children like most about engineering and technology after seeing more information?

After seeing further information, children said they liked that engineering and technology were different, looked a lot of fun, would be very interesting, it is not all about fixing engines, helping people could be a part of the job, jobs in the music industry looked interesting, it would be an exciting area to work in, and that design and creativity were aspects of these careers.

What methods can be used to make children feel more positively about careers in engineering and technology?

Three in five children suggest having school trips to see what engineers really do, whilst more than half also choose visits to school from engineers, or an engineering / technology club at school.

Girls are marginally more keen than boys to get out there and see what engineers actually do, whereas boys are more positive about engineering / technology clubs and more practical activities in school.

Compared to 2015 - School trips and visits to school from real engineers are still the top two choices for children aged 9-12, but marginally fewer children choose these and other initiatives this time around. Children this age are now more likely to choose short stories / books about engineering and open days, as good ways to promote engineering and technology in a positive way to young people.

"I would want someone to come and talk to us…or a video of someone actually doing the job."

Secondary aged girl

Research Findings

Parents:
Parents' influence on their children's choice of career can be both deliberate, giving help and advice where needed, or more subtle, with children picking up on their parents' own views and opinions on jobs and careers, both positive and negative.

Gender specific influence can creep in from a young age, when parents consider which STEM subjects they want to encourage their children with.

▬ Help and support with STEM subjects

Which subjects do parents actively encourage and want their children to do well in?

Legend: ■ Parents of Girls   ■ Parents of Boys
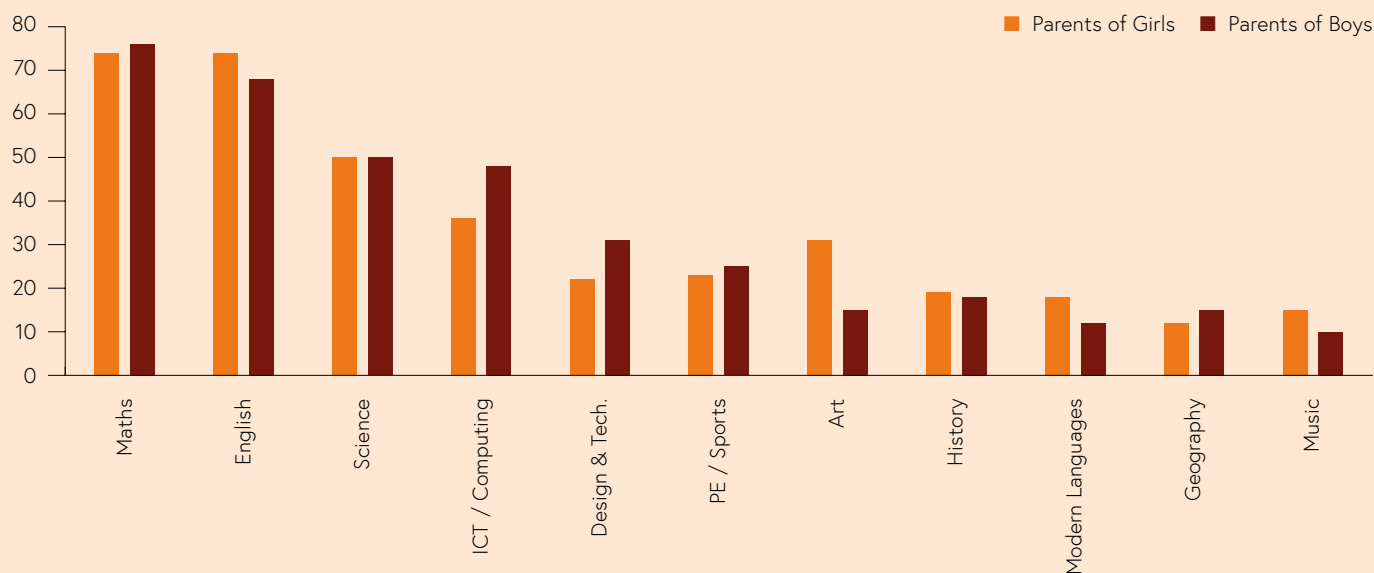
Maths is the subject parents give the most encouragement with, followed closely behind by English. Science, ICT / Computing and Design and Technology complete the top five.

Parents are slightly more likely to encourage progress in STEM subjects as children get older, but increases are relatively small, suggesting that support for these subjects is something that is either recognised from a young age or not at all.

"Maths is something she is very strong at. She sat there doing homework this morning (and asked me) can you check this for me?"

Dad of secondary aged girl

Parents of boys are more likely to encourage their sons to do well in ICT / Computing, Design and Technology. They are marginally more likely to encourage them in Maths and are equally likely as parents of girls to nurture their interest in Science.

Parents of girls are more likely to actively encourage their daughters and want them to do well in English, Art, Modern Languages and Music.

From the in-depth interviews – Most parents understood the broader spectrum of STEM subjects and applauded the encouragement of Science, Maths and Technology subjects. Parents talked about supporting and encouraging their child's interests and aspirations, and being guided by the pace and enthusiasm of their child.

"She likes science…but I don't think she knows it is science…making exploding rockets with bicarbonate of soda and lemon juice, she wouldn't know it was science, she would just think it was something that we do. It is fun."

Mum of primary-aged girl

"I think, basically getting him to do as well as he can so his options are open. Basically express to him the kind of core subjects that are really needed for everything…Maths, strong, Science, probably strong. English you have to do well. You know, the core subjects. So wherever his interests lie, he is able to follow that path."

Dad of Secondary aged boy

"It depends on your own personality doesn't it? I think having the older children makes you see that more…my eldest one is very academic, she likes to get things right, she loves to be tested. My middle one really struggled at school and you know, now she has left school, she is excelling in herself, school wasn't the right environment for her and so I think that makes you realise that as well, what works for one isn't necessarily going to be right for the other. And it doesn't matter what you put in as a parent, they are still different."

Mum of primary-aged girl

Parents' aspirations for their children's careers

When parents think about their child's career, very clear gender stereotypes emerge. Parents of girls think they would be most interested in the Arts, Education and Childcare, Healthcare and Hair and Beauty, whilst parents of boys think they would most like to go into Technology, Information Technology, Engineering, and Sport.

Technology and engineering both feature in the top five careers that parents think their children would be interested in, but these positions are inflated by the expectations of parents with boys – especially in the case of engineering. Parents with girls are much less likely to think their daughters would be interested in a career in either of these industries.

The only career that girls themselves are more interested in than their parents think they are, is engineering.

Compared to 2015 - The Arts is the industry that parents of 9-12 year olds now think their child would be most interested in, with the top choice in 2015, Information Technology, slipping back to third place. Other industries that parents think their child would be more interested in, in 2019, include Design, Engineering, the Environment, and Construction and Property, whereas fewer parents now think their child would be as interested in Information Technology and Science.

From the in-depth interviews – Parents identified a wide range of industries that they thought their child might be interested in, when prompted with a list. Technology rated highly (especially among parents of boys), whereas engineering was chosen almost exclusively by dads. Where engineering was discounted, it was generally because parents didn't know enough or didn't think their child knew enough about what it would involve.

"I don't think (she) knows enough about (engineering), she doesn't know what it is, so I don't think she could say that she would want to do something in that particular group of jobs."

Mum of primary aged girl

"Engineering is varied. There's a lot of, obviously, different areas, different aspects and different skill sets. But if the Maths and Science were strong, I think I would (encourage it)."

Dad of secondary aged boy

Which careers do parents think their children would be interested in?

Bar chart legend: ■ Parents of Girls ■ Parents of Boys
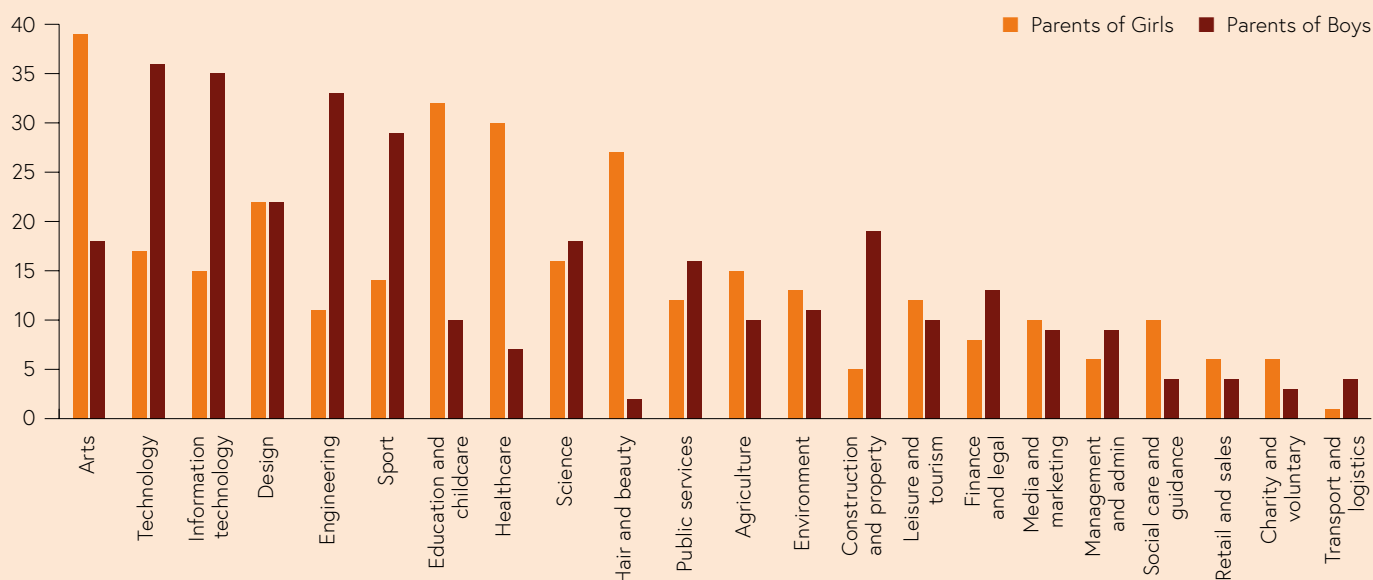
Parents' views on engineering and technology careers for their children

## How much do parents know about engineering and technology?

Nearly half of all parents agree that if their child came to them asking for advice about a career in engineering and technology, they would know enough to help them, but more than one in five feel they don't know enough, with parents of girls typically less confident that they know enough to help.

The majority of parents think that jobs in engineering and technology are for boys and girls alike, but a significant minority feel these jobs are still more for boys, and parents of girls are even less convinced that jobs in engineering and technology are for boys and girls.

"When I started as a graduate Engineer twelve of us were taken on and there were a few females but they were taken on in commercial roles as opposed to engineering roles and so all of the graduate engineers that were taken on were male. But in the business there are female engineers and where I am working now there are a few, not many."
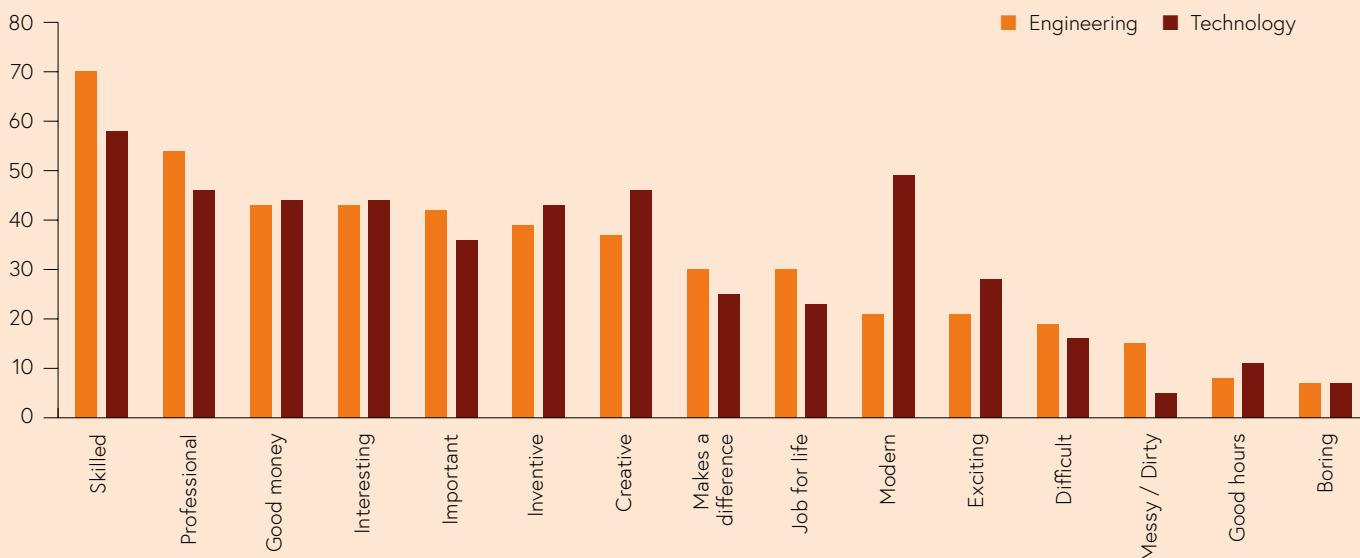
Dad of secondary aged girl

Can parents spot characteristics and behaviours that would make their child a good candidate for a career in engineering or technology?
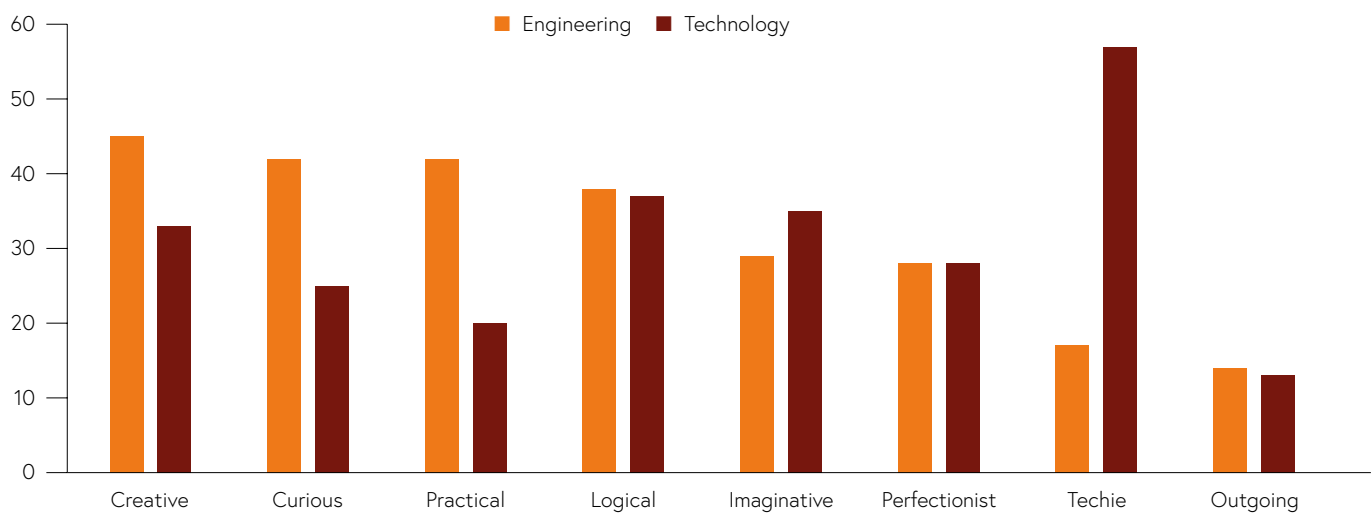
When asked what would make a child a good candidate for a career in engineering or technology, parents highlight very different characteristics. Children that could become engineers are creative, curious and practical, whilst those that could work in the technology sector would need to be techie, logical, and imaginative.

What words would parents use to describe jobs in engineering and technology?

Legend: **Engineering** (orange) **Technology** (dark red)

Word	Engineering	Technology
Skilled	70	58
Professional	54	46
Good money	43	44
Interesting	43	44
Important	42	36
Inventive	39	43
Creative	37	46
Makes a difference	30	25
Job for life	30	23
Modern	21	49
Exciting	21	28
Difficult	19	16
Messy / Dirty	15	5
Good hours	8	11
Boring	7	7

Most parents describe jobs in engineering as skilled or professional, with a significant minority saying these jobs provide good money, are interesting and important.

In comparison, parents are more likely to describe jobs in technology as modern, creative, exciting and inventive.

Parents are three times more likely to describe engineering jobs as messy / dirty compared with technology jobs, and marginally more likely to describe them as difficult, with parents of girls especially likely to feel this way.

Compared to 2015 – Since 2015, parents of 9-12 year olds are now much more likely to describe jobs in engineering as making a difference, as well as more important, modern and interesting. They are now less likely to see these jobs as messy / dirty or difficult.

From the in-depth interviews – Many of the parents struggled to really understand what engineering is or what an engineer does, and so they found it difficult to predict what characteristics would be most useful. Among those who were able to appreciate the wider elements of engineering – the scientific, creative and technical roles – perceptions of working in the industry were far more positive. They talked about opportunities for problem solving, troubleshooting, imagination, structure and building.
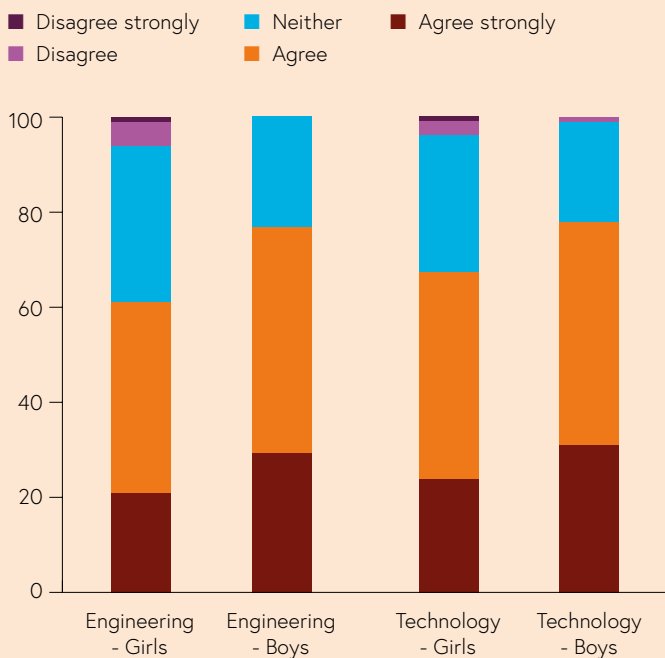
"In the past...as an Engineer it would be more the messy hands-on fixing cars and that kind of engineering and maybe building cars and stuff. Whereas I think now engineering has moved with the times."

Dad of secondary aged girl

"I think a part of it may be also the way you introduce it…the social connotations. Because if for instance a child from a working class background…if their parents say to them engineer, they might be talking about the British Gas engineer that comes to check a meter. He is doing some manual work. From that perspective this child may say, ok that's an engineer. You may have people from a more professional middle-class background. And they may say Civil Engineer and what have you. You know someone designed this bridge, this new bridge or this new building. That's an engineer. So their idea of what an engineer is, again, could be totally different. And then that determines whether or not you may see that as a career path that you would like to explore."
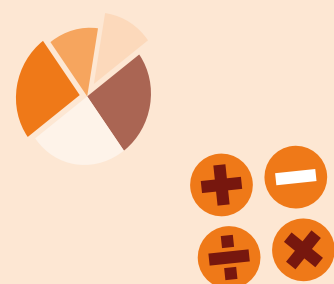
Dad of secondary aged boy

Would parents encourage their child into a job in engineering or technology?

- ■ Disagree strongly
- ■ Disagree
- ■ Neither
- ■ Agree
- ■ Agree strongly

Chart y-axis: 0, 20, 40, 60, 80, 100

Categories: Engineering - Girls, Engineering - Boys, Technology - Girls, Technology - Boys

The majority of parents say they would encourage their child into a career in engineering or technology, but parents of girls are much less likely than parents of boys to agree.

Dads are more likely than mums to agree they would encourage their child into engineering or technology, especially dads of boys, and conversely, mums of girls are much less likely to want to encourage their daughters into these careers.

"I would probably move it over to the pile for Evie now, now that I know there is such a vast variety of different things that they can do. And it can be a lot more creative. Maybe the school narrow it down too much."

Mum of primary aged girl

Why would parents encourage their child into a job in engineering or technology?

Engineering

Technology

Most parents would encourage their child to go into engineering or technology, and the majority of these would do so simply because it is a good career.

For engineering specifically, parents say their child is interested in this sort of career, it is a job for life, it requires useful skills, and it provides good career prospects. For technology, parents say they would encourage their child as it is the future, their child has shown an interest in this and that there are great job opportunities.

▬ Providing parents with information on engineering and technology careers

Would parents encourage their child into a job in engineering or technology, after seeing the sorts of people who work in the industry, and the variety of jobs involved?

After seeing further information, three in four parents agree they would like to know more. Two in three had no previous ideas about the variety of jobs in these two industries, or that creativity and art were involved in these jobs.

The majority also hadn't realised these careers could be so interesting or exciting, or importantly, that there were so many opportunities for girls and women.

Before seeing further information, the majority of parents said they would encourage their child into engineering or technology. After reading this information, agreement increased, especially so for careers in engineering, and also most amongst parents of girls.

Compared to 2015 - Amongst parents of 9-12 year olds, general interest in encouraging their child into engineering has increased over time. After being exposed to the information, almost four in five parents would encourage their child into engineering, up from seven in ten in 2015.

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Would parents encourage their child into a job in engineering or technology, after seeing the sorts of people who work in the industry and the variety of jobs involved?

Parents felt that their child would be interested in a career like this, or that it suited their child's interests after seeing career examples. They also felt their child would like the variety of a career in these areas, and that it offered a lot of different options. They also mentioned that it was a career where you could help others, that jobs in music and sound engineering would appeal, that the involvement with computers is of interest, or that it involves creativity.

"In this day and age there is a massive disconnect and people don't necessarily see the hard work that goes behind things. So it needs to be reintroduced and repackaged for children nowadays."

Dad of secondary aged boy

"People going into schools…
if they had a careers fair at high school with someone in those roles, rather than just a teacher who has taught it for 100 years, he might have been more interested in it, if he had known that there was the aerospace, there was the sports, there was disaster relief or whatever. I think it would have made it more real to him, he could have seen where it could have taken him."

Mum of secondary aged boy

What methods do parents think can be used to make them feel more positively about careers in engineering and technology for their children?

The most popular ways to promote engineering and technology are to arrange more related activities for children in school, more visits to schools from young engineers, and more information about the different types of jobs available.

Parents of girls were especially likely to want to see more female role models in engineering and technology.

Compared to 2015 - The number of parents agreeing that any of these options would help to promote engineering and technology positively among children has dropped since 2015, but they are no more likely to suggest alternative ideas. This suggests that more needs to be done to create new and interesting methods to promote engineering and technology.

From the in-depth interviews – Parents agreed that, to make engineering more appealing, we need to make more noise about it and make it sound as exciting as it looks. Activities such as workshops in schools should show children the fun side of engineering, the breadth of roles available, and also give them the opportunity to experience roles rather than just read about them.
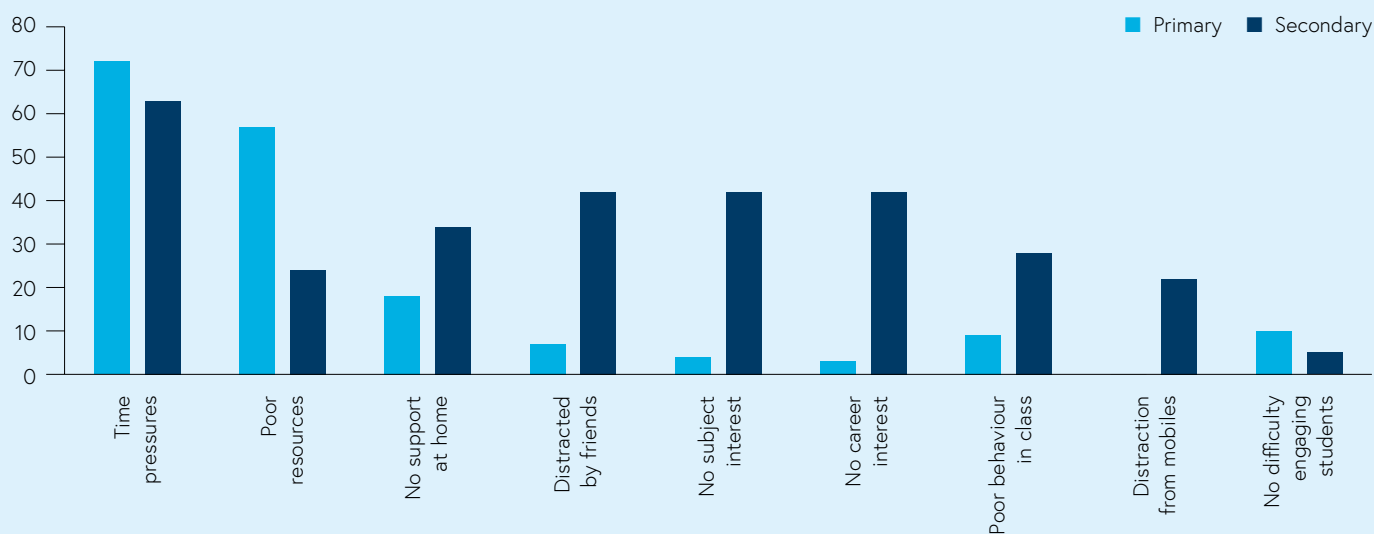
Research Findings
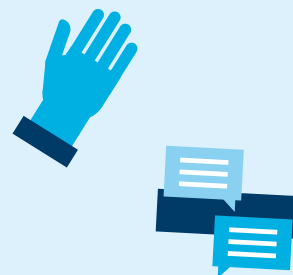
Teachers:
After parents, teachers are the next major influence on children, especially at primary age, where the presence of an inspirational teacher can set up patterns for life.

Teaching STEM subjects

What are the biggest difficulties teachers face when trying to engage students in STEM subjects?

Bar chart legend: ■ Primary ■ Secondary

Category	Primary	Secondary
Time pressures	72	63
Poor resources	57	24
No support at home	18	34
Distracted by friends	7	42
No subject interest	4	42
No career interest	3	42
Poor behaviour in class	9	28
Distraction from mobiles	0	22
No difficulty engaging students	10	5

Whilst both primary and secondary teachers say that time pressures of having to teach the full curriculum is their biggest obstacle to engaging students in STEM subjects, the responses from primary and secondary teachers then differ greatly.

For primary teachers, poor resources are a difficulty for more than half, and a small proportion feel their students have no support from home.

Secondary school teachers face far more potential difficulties than primary teachers – two in five feel that their students get distracted by their friends, or are not interested in the subject or a career in that field, and one in three say their students have no support at home and poor behaviour in class or distraction from mobile phones are also a problem.

From the in depth interviews - Teachers agreed that some lessons were naturally going to be less interesting or 'boring' for students. At secondary school this applied to subjects that were abstract and required students to use their imagination, over being able to actually see something in action, such as radiation and particle science. They also suggested that lessons where students couldn't see the relevance of what they were learning could be less engaging. On the other hand, the more enthusiastic teachers noted it was their role to ensure students were made aware of why it was important to learn a certain topic, and have it made as relevant as possible to them.

Do teachers notice any differences in the way that girls and boys engage with STEM subjects?

Whilst most teachers feel that there is no difference, at primary school a significant minority feel that boys engage better, but by secondary age an almost equal number of teachers feel girls also engage better.

Teachers who thought boys engaged with STEM subjects better than girls mentioned that a lot of this was for 'traditional' reasons, with STEM being perceived as male dominated subjects, and that this is perpetuated at home and in the media. Others said that boys tended to be more practical and hands on than girls, and generally more confident in their abilities in this area.

Secondary teachers who thought girls engaged with STEM subjects better than boys mentioned that girls tended to have a better work ethic, were more keen to learn in all subjects, and less likely to get distracted in class.

"Boys tend to throw themselves in head first. Girls are more calculating in their decision making, fear of failure means girls tend to go for subjects they think are easier and more likely to get better results in!"

Secondary school teacher, North East

"Traditional gender roles are still enforced in some households - this is then shared by children with each other. There are always more girls in dance club and more boys in coding club, despite the fact we try to balance them as much as we can."

Primary school teacher, South East

"Girls are more focussed on wanting to succeed regardless of the subject, so they want to do well. There is a difference between girls / boys amongst the science subjects."
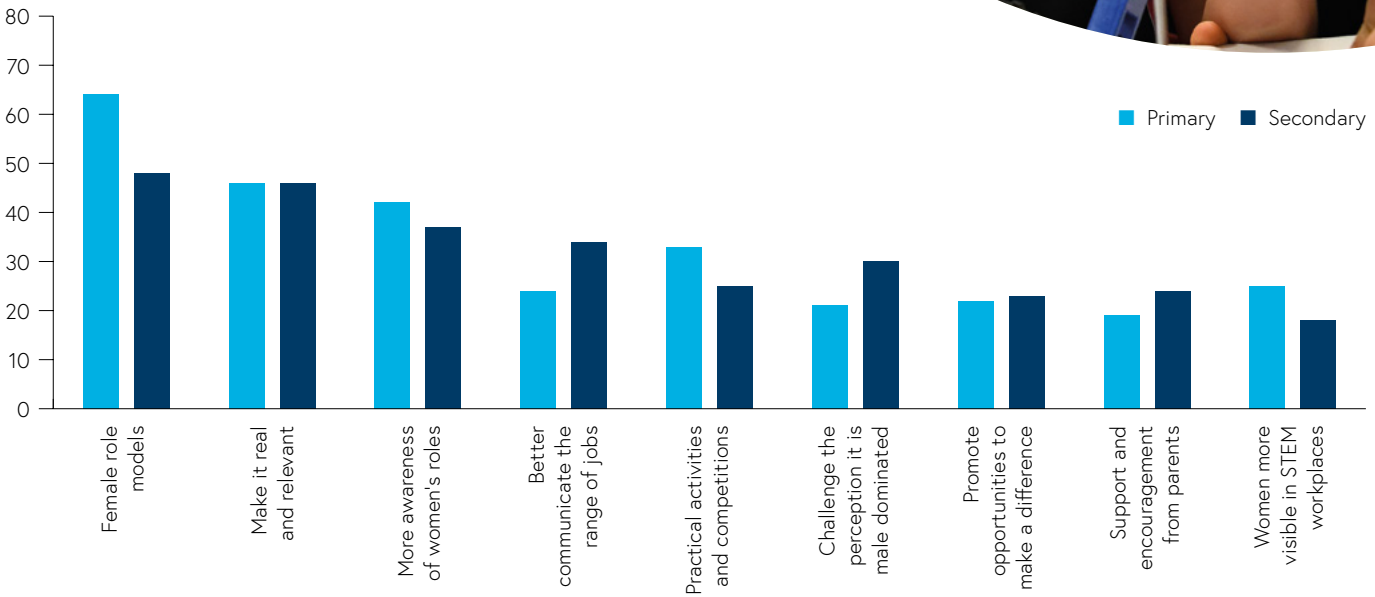
Secondary school teacher, Yorkshire

## What do teachers think would help and encourage more girls to engage with STEM and consider it as a potential career choice?

Legend: ■ Primary ■ Secondary

Chart categories (with approximate values, Primary / Secondary):
- Female role models: 64 / 48
- Make it real and relevant: 46 / 46
- More awareness of women's roles: 42 / 37
- Better communicate the range of jobs: 24 / 34
- Practical activities and competitions: 33 / 25
- Challenge the perception it is male dominated: 21 / 30
- Promote opportunities to make a difference: 22 / 23
- Support and encouragement from parents: 19 / 24
- Women more visible in STEM workplaces: 25 / 18

More than half of teachers said that giving girls the opportunity to meet female role models was the most important way to engage them more with STEM.

Two in three primary school teachers thought exposing girls to female role models would help, compared to half of secondary school teachers, although it remains the top choice amongst both primary and secondary teachers. This highlights how important it is to do this at a young age, before general stereotypes of a male dominated STEM workforce take hold.

From the in-depth interviews - All teachers agreed on the importance of female role models, to give girls a clear picture of something to aspire to. They discussed role models coming into schools to lead talks and presentations/demonstrations about their work and the steps they took to get there; taking students to their workplaces to see first-hand their 'world of work' and appearing on TV and social media more generally.
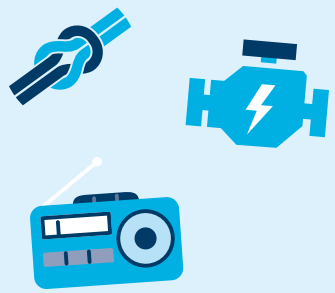
Promoting STEM careers in school

How often do teachers incorporate information about possible STEM careers into lessons?
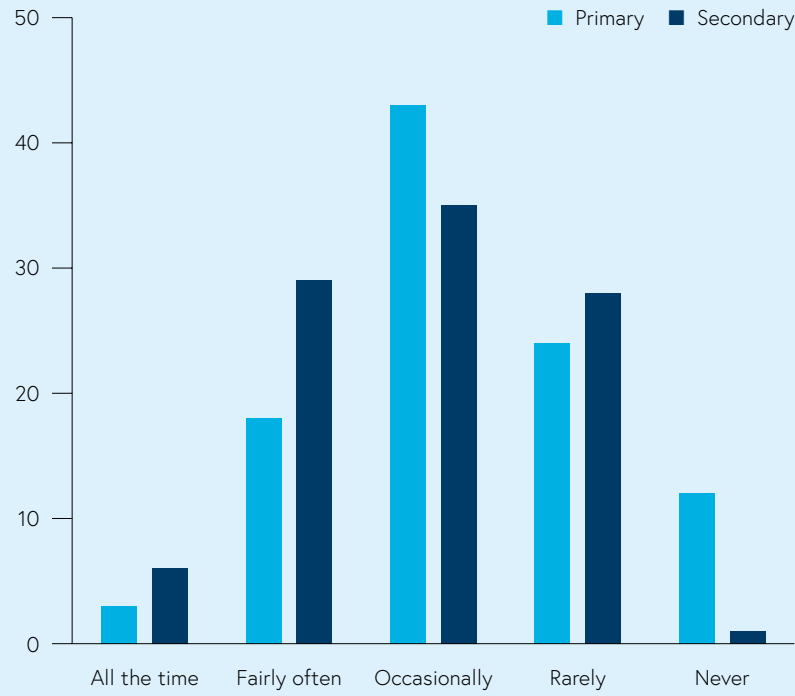
Primary ■ Secondary ■

	All the time	Fairly often	Occasionally	Rarely	Never
Primary	3	18	43	24	12
Secondary	6	29	35	28	1

Whilst teachers will occasionally incorporate information about STEM careers into their lessons, it is a minority who manage to do this frequently. One in four teachers rarely do this, and around one in twenty never include STEM career information in their lessons, mainly as they don't have the time to look for or use these in lessons, but also as they don't know enough about these resources.

Secondary school teachers, whose students are closer to the world of work, are more likely than primary school teachers to include STEM career information in their lessons more often, whilst primary teachers are much more likely to never do this.

From the in-depth interviews - Secondary teachers talked about careers where possible, to bring lessons to life, especially when they were talking about abstract ideas. There is less of a focus on careers overall in primary school, although teachers do bring this up more at Year 6, their last year before moving up to secondary school.

How much do teachers think children are aware of the potential careers available in the STEM industries?

Most teachers were confident their students knew at least a little about the potential careers available in STEM, although the amount they thought students knew varied by STEM subject area, highest in Science, lowest in Mathematics.

Secondary school teachers were more confident that their students knew a lot about the potential careers available in STEM. The overall knowledge gap was widest for engineering, with one in three primary teachers and one in eight secondary teachers saying their students know nothing about careers in this area.

From the in-depth interviews – Teachers' knowledge about STEM careers came from their personal experiences of study; previous careers; drawing on the experiences of their friends and family, and ideas learnt from school visits to employers, or experts and STEM ambassadors who came into the school.
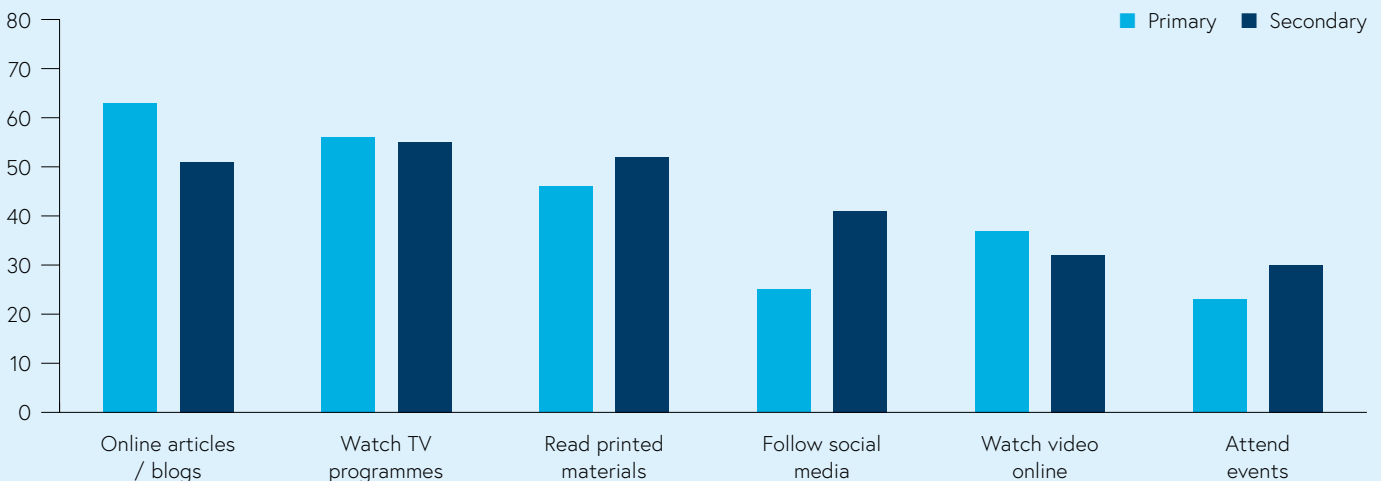
> "I want to raise the profile of STEM careers in schemes of work, but training is necessary as teachers' knowledge is limited. A lot wouldn't encourage STEM careers, for fear of not saying the right thing."
>
> Secondary school teacher, North West

≡ Teachers' knowledge of the engineering and technology industries

How do teachers find out about the engineering and technology industries?

■ Primary ■ Secondary

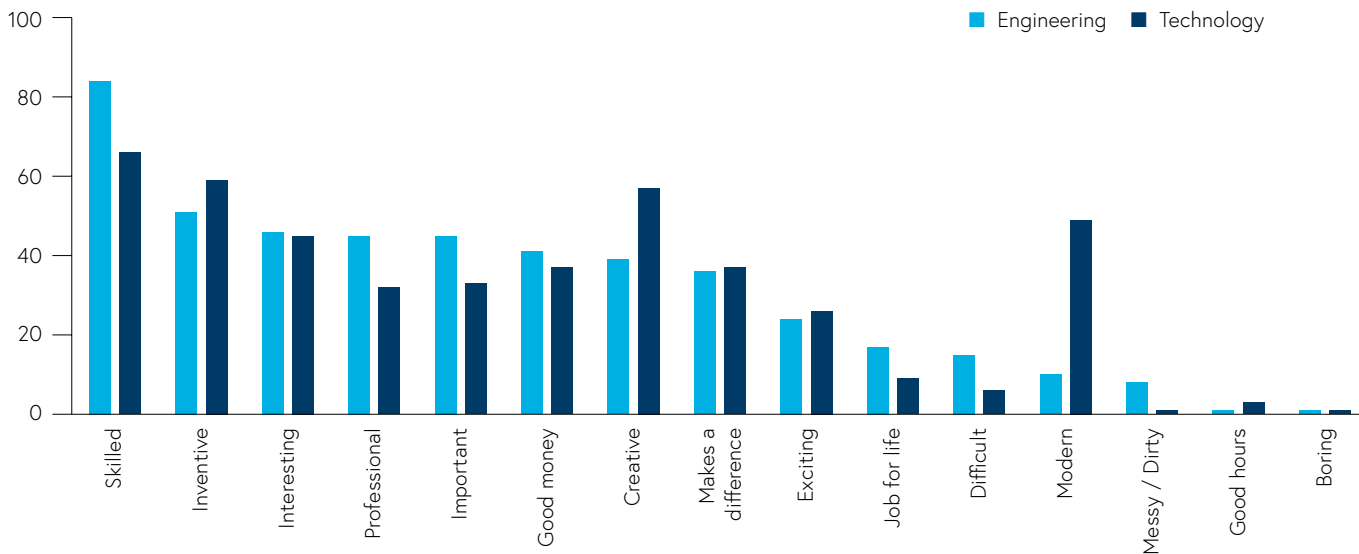|	Online articles / blogs	Watch TV programmes	Read printed materials	Follow social media	Watch video online	Attend events
Primary	63	56	46	25	37	23
Secondary	51	55	52	41	32	30

Secondary school teachers, whose students will be thinking about life post school and their eventual career paths, are more likely than primary teachers to know about both engineering and technology industries, but significant minorities know nothing at all.

Teachers find out this information mainly from reading articles or blogs online, watching TV programmes on the subject, or reading newspapers, magazines, and industry journals. Four in five teachers also know someone who works in the fields of engineering or technology.

From the in-depth interviews – Most teachers admitted knowing nothing or very little about engineering. Those who did know more, had personal experience through studying it at university or teaching it at GCSE. Given most teachers knew very little, this meant they weren't able to tell students much about the industry if anything and where possible instead referred them to school careers services or local employers they knew had an engineering background.

Which words would teachers use to describe jobs in the engineering and technology industries?

■ Engineering   ■ Technology

Categories (left to right): Skilled, Inventive, Interesting, Professional, Important, Good money, Creative, Makes a difference, Exciting, Job for life, Difficult, Modern, Messy / Dirty, Good hours, Boring

Teachers' and parents' responses to this question were very similar, although differences between engineering and technology were more pronounced amongst teachers.

Most teachers describe jobs in engineering as skilled, or inventive, with a significant minority saying these jobs are interesting, professional, important, and provide good money.

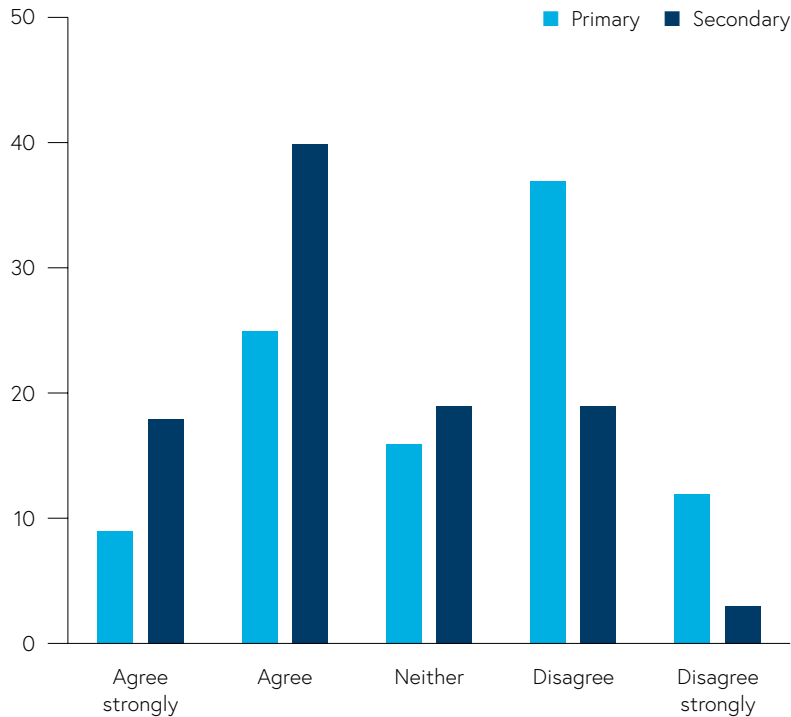In comparison, teachers are more likely to describe jobs in technology as creative, modern, and inventive.

"I tell my students about BAE where I can, and that engineering and STEM offers a good future. I push them to look up BAE and the other local car manufacturers. However, I feel my own awareness of engineering needs to increase before I can tell students about it. And I need to know where the engineering principles link to my subjects."

Secondary school teacher, North West

Promoting engineering and technology careers in school

Do teachers know enough to help their students if they asked for advice about a career in engineering or technology?

Legend: Primary | Secondary

Chart categories (x-axis): Agree strongly, Agree, Neither, Disagree, Disagree strongly

Encouragingly, no teachers would actively discourage their students from considering careers in engineering and technology, with these opinions differing little across primary and secondary schools. This shows that teachers are keen to keep their students' career options open, even from a young age.

However, when asked if they felt they knew enough to help their students if asked for advice, opinion was somewhat divided. Secondary school teachers were far more likely than teachers at primary level to feel they had adequate knowledge to help.

Providing teachers with information on engineering and technology careers

Does seeing further information change teachers' opinions about potential careers for young people in engineering and technology?
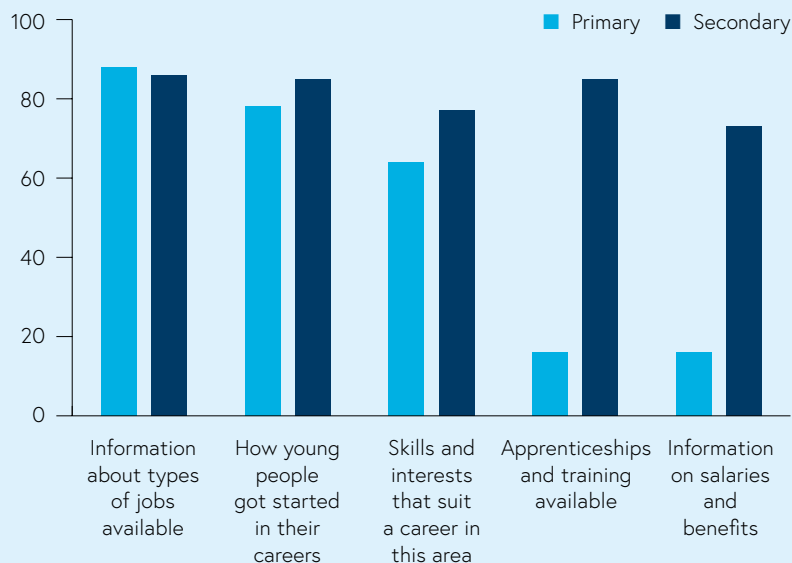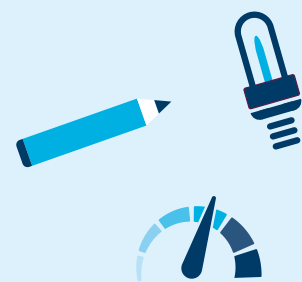
After seeing a small amount of additional information, three in four teachers said this had helped to change their opinion about the potential careers available to young people.

Primary school teachers, potentially less exposed to careers information than their secondary counterparts, were twice as likely to say that the case studies had changed their opinion a lot. A total of four in five primary school teachers said it changed their opinion, compared to two in three secondary teachers.

When asked, the vast majority of teachers, across all subgroups, would now like to know more about the different careers available in engineering and technology.
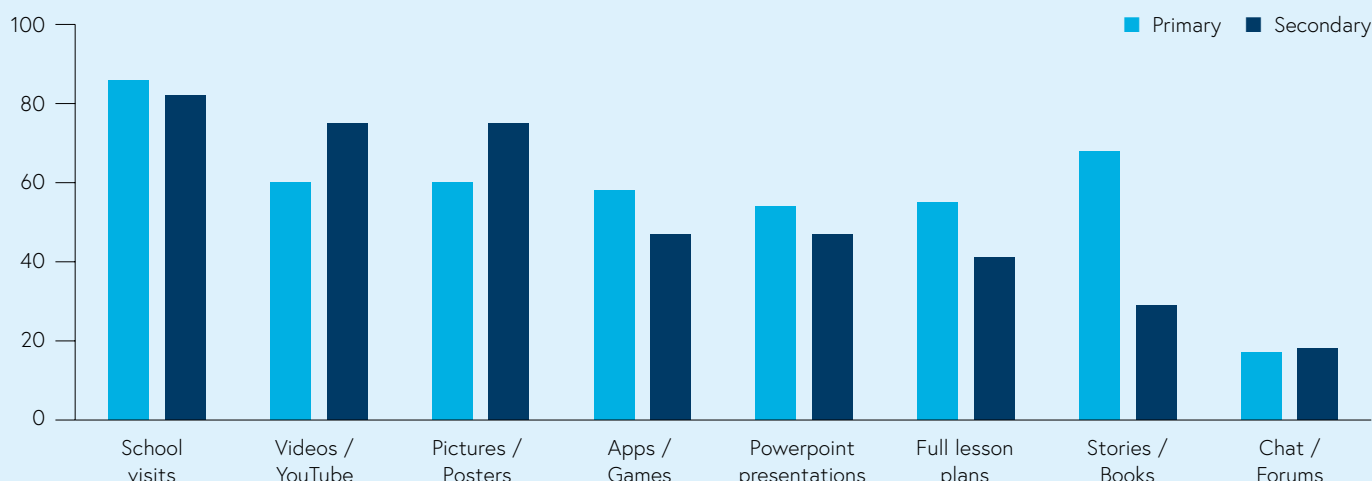
What information about careers in engineering and technology would teachers find the most helpful?

Legend: ■ Primary ■ Secondary

Chart (values approximate, y-axis 0–100):
- Information about types of jobs available: Primary 88, Secondary 86
- How young people got started in their careers: Primary 78, Secondary 85
- Skills and interests that suit a career in this area: Primary 64, Secondary 77
- Apprenticeships and training available: Primary 16, Secondary 85
- Information on salaries and benefits: Primary 16, Secondary 73

Teachers were keen to get information about the different types of jobs available, how young people started their career in this area, and the sorts of skills and interests that suit a career in this area. Secondary school teachers also requested information about apprenticeships and training, and salaries and benefits of jobs, both of which would be more immediately relevant to students in their final years before leaving school.

What resources about careers in engineering and technology would teachers find the most helpful?

Legend: ■ Primary ■ Secondary

Chart (values approximate, y-axis 0–100):
- School visits: Primary 86, Secondary 82
- Videos / YouTube: Primary 60, Secondary 75
- Pictures / Posters: Primary 60, Secondary 75
- Apps / Games: Primary 58, Secondary 47
- Powerpoint presentations: Primary 54, Secondary 47
- Full lesson plans: Primary 55, Secondary 41
- Stories / Books: Primary 68, Secondary 29
- Chat / Forums: Primary 17, Secondary 18

Resource wise, teachers overall were most interested in having STEM ambassadors visit the school, but the other resource needs of primary and secondary teachers are very different.

To cater for the age of their students, a majority of primary teachers want stories and books featuring engineering and technology to engage their children, whilst for secondary teachers, short form content such as YouTube videos, and pictures / posters to put up in class come to the fore.

From the in-depth interviews – Further requests of such resources were that they were good quality, made clear how they linked to the curriculum, and brought both the curriculum and career to life by showing how lessons related to the specific job role, whilst also making the job seem interesting. Teachers also wanted the resources to show career paths and where possible that they included past pupils, so the students could better relate to them.
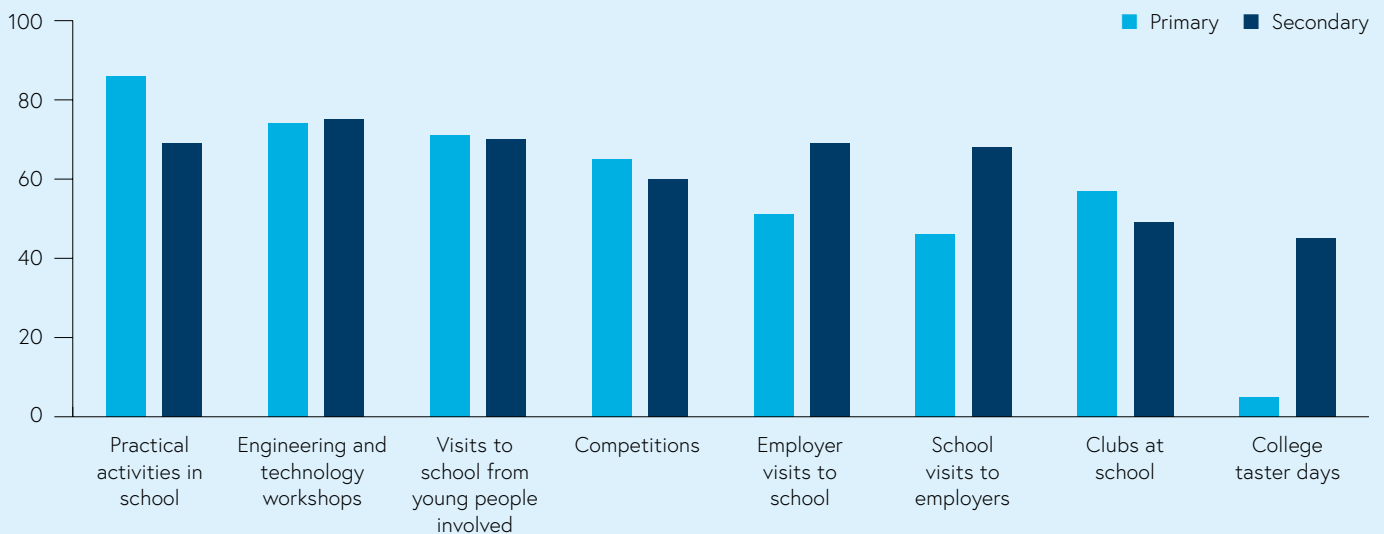
"I want more pictures and short clips, some with the lifestyle of the person, showing how a career can take you from nowhere to somewhere, what do you do in your job, how is that helpful. People think engineering is boring, girls think it's all electronics and machines, which will put them off. But they don't know the reality, or the reward. I want inspired video clips, a person talking about their background, and the difference their job has made to their life."

Secondary school teacher, North East

What activities around careers in engineering and technology would teachers find the most helpful?

Legend: ■ Primary ■ Secondary

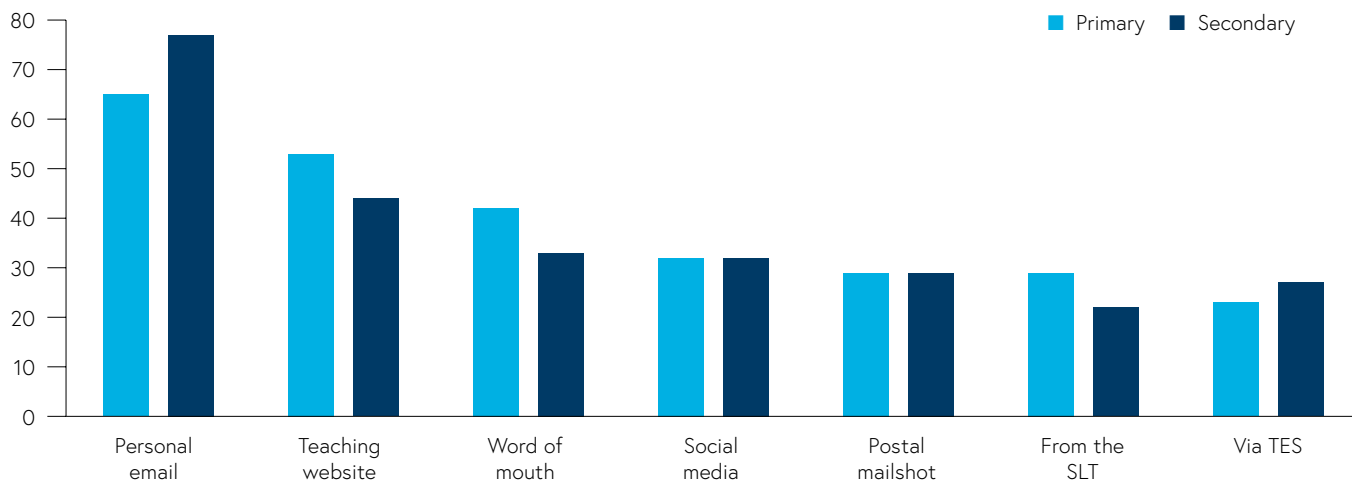| Activity	Primary	Secondary
Practical activities in school	86	69
Engineering and technology workshops	74	75
Visits to school from young people involved	71	70
Competitions	65	60
Employer visits to school	51	69
School visits to employers	46	68
Clubs at school	57	49
College taster days	5	45

Primary school teachers want practical activities to use in class to engage their children in engineering and technology, whereas secondary teachers opt for more vocational activities, such as employer visits to school, or vice versa, and college taster days.

How would teachers expect to find out about this information, or these resources and activities?

Legend: ■ Primary ■ Secondary

Categories (x-axis): Personal email, Teaching website, Word of mouth, Social media, Postal mailshot, From the SLT, Via TES

The most popular way teachers would expect to find out about these sorts of resources, activities and information is by personal email - this method is probably the most direct and reliable of those listed, can be acted upon at any time, and only requires teachers to sign up to receive emails rather than have to actively seek out information (on websites for instance).

Conclusions and recommendations

The report conclusions build on the results from the 2015 survey and highlight the key areas we are committed to improving and will continue to prioritise through our charitable and education outreach, as well as our work in reaching and engaging with young people from all backgrounds.

Raise the profile of modern engineering among young people, and ensure that parents are better informed about careers in the profession

– Engage children from a young age with fun and practical activities (e.g. live experiments, visits to schools, competitions, open days).
– Help children to appreciate the impact that engineering has on their daily lives – e.g. gaming, sports, and also the environment (this is likely to become increasingly important over time, and it's an area that is of particular interest to girls).
– Produce promotional and marketing materials which direct parents to the relevant skills a child needs to pursue a career in engineering.
– Showcase careers within high profile companies and organisations, places they would aspire to work, by showing the lifestyle of a modern day engineer.
– Consider partnerships with other organisations, including high profile household brands (e.g. supermarkets) to provide a list of boredom busting activities for school holidays.
– Run events during the school holidays – parents are often looking for local activities and days out (especially free ones), that can be planned in advance.

Communicate the breadth of engineering careers to young people and their parents

– Position engineering jobs in their wider context, keeping options open.
– Emphasise aspects of art and creativity to widen appeal.
– Highlight environmental roles – these are likely to become more important over the next few years, with interest in this area growing steadily.
– Promote accessibility by showing children and parents a clear path of progression and opportunities for training.
– Consider partnerships with other organisations, to help promote the creative and technological aspects of engineering.
– Ensure that communication is regular and consistent, and that it promotes material that families can identify with and relate to – this will help to make it more memorable in the long run.

Prevent children (especially girls) becoming disillusioned and disengaged by STEM subjects

- Help teachers to create a learning environment that breaks away from passive instruction wherever possible, allowing for more play and investigation.
- Start young. Early education needs to tap into children's natural curiosity and give them more opportunities to be active and engaged in their own learning.
- Improve the relevance of school resources to help keep children more engaged, as well as allowing more opportunities for them to get hands on experience.
- Launch and promote more competitions and fun events to help focus children's interests, especially at primary level.
- Ensure that teachers understand the different learning styles of boys and girls so that they are able to create a learning environment that meets the needs of both.
- Female role models are the key to engaging primary girls especially, igniting interest from a young age that may set them on a path for life.
- Offer more opportunities for girls to experience STEM in a girl-only environment e.g. clubs at school, group work in class.

Areas where there are differences within BAME families

- Children from BAME families are more likely to enjoy Maths, and Design and Technology, but there is little difference in levels of enjoyment for Science and ICT / Computing.
- BAME parents are generally more likely to actively encourage their children in STEM subjects – with the only exception to this being ICT / Computing.
- However, BAME children are less likely to identify Science as a subject that could lead to a career in engineering or technology – although BAME children enjoy science, more needs to be done to convey how science qualifications are valuable and transferable for a wide range of careers, including engineering and technology.
- Children from BAME families are less likely to approach their dads for support with STEM work, but instead are more likely to turn to siblings and friends - they are also more likely to say they get no support at all.
- BAME parents were most surprised to learn that creativity and art are involved in engineering and technology careers, but also that these could be so interesting, and that there are so many opportunities for girls and women.
- BAME parents were more likely to encourage their child into engineering and technology, before seeing our case studies, so the uplift for them isn't so great after seeing more information.

For more information about STEM support and resources available to primary and secondary schools, visit:

Primary: faraday-primary.theiet.org
Secondary: faraday-secondary.theiet.org

For more information and activities for young people linked to STEM and careers in engineering and technology, visit:

engineer-a-better-world.org

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