University technical college students' perceptions and experiences of studying engineering

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Abstract

University Technical Colleges (UTCs) aim to provide a technically-oriented curriculum for 14-19 year olds. Technical learning with state-of-the-art equipment is integrated with academic subjects such as English, maths and science to support pupils' technical learning. The UTC curriculum aims to become highly regarded and to establish parity of esteem between technical and academic pathways of study.

Focus group discussions took place in two UTCs in the Midlands area of England. Forty nine Year 10 pupils shared their experiences of studying the Engineering Diploma. Focus group discussions explored why pupils chose to study at a UTC, their perceptions and experiences of engineering and their plans for the future. Discussions also examined how the UTC learning environment is perceived by its students.

Most of the UTC students reported feeling highly motivated. They described a culture where working hard most of the time is normal and suggest that a desire to learn is required to attend a UTC. Compared to their previous schools, they reported that it was easier to learn in smaller classes with fewer disruptive students. They enjoyed their Engineering lessons but would prefer more time in the workshop as they liked the "hands-on" element of the subject. Students reported more planning activities which enabled them to take more responsibility for their own learning. Some students reported that they had transferred the planning skills that they had learnt in Engineering to other subjects.

The longer hours associated with attending a UTC meant that students frequently reported being unable to socialise with their friends. Many students felt that the UTC's extra-curricular activities made the day seem unnecessarily long and they would prefer participation to be optional not compulsory. However, these compromises were judged to be worthwhile due to the benefits of attending a UTC. These included: being treated more like adults, the involvement of employers and access to state-of-the-art equipment.

Overall, the UTC students reported high levels of motivation and self-regulated learning. However, it is not known if this is due to more able students self-selecting to attend UTCs. This is being explored further in a quantitative survey of learning and motivation in UTC and comprehensive school students. This study is part of a wider longitudinal programme of research into technical education.

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1. Introduction

1.1. University Technical Colleges

The aim of University Technical Colleges (UTCs) is to provide a technically-oriented curriculum for 14-19 year olds while integrating national curriculum requirements such as English, maths and science to support pupils' technical education. The first UTC opened in September 2010 and there are currently five UTCs operating in England (see Table 1).

Table 1   List of open UTCs in England as of September 2012.

UTC	Local Authority	Specialism	Date Opened
JCB Academy	Staffordshire	Engineering and enterprise	September 2010
Black Country	Walsall	Engineering and science	September 2011
Aston	Birmingham	Engineering and Science	September 2012
Central Bedfordshire	Central Bedfordshire	Engineering, manufacturing and product design	September 2012
Hackney	Hackney	Digital media and healthcare	September 2012

Developed by the Baker Dearing Trust, UTCs are 14-19 schools that are independent from local authority control while receiving state funding through the Academies programme (Fuller & Unwin, 2011). Each UTC must be sponsored by a further education college, a university and an industrial partner who are all involved in developing the curriculum. For example, the Black Country UTC is sponsored by Walsall College and Wolverhampton University in partnership with Siemens. Each UTC has a specific technical focus related to local industry needs and the university and industry sponsors' areas of excellence.

UTCs have a longer day that replicates workplace hours of 8.30am to 5pm. Teachers are supported in the classroom by learning mentors who observe and evaluate students' performance and development. The curriculum is split so that students spend 40 per cent of their time studying the technical specialism of their UTC. The remaining 60 per cent is spent studying core academic subjects such as English, maths and science. UTCs have an 'integrated curriculum' to bridge the academic/vocational divide. The sponsors collaborate to conceive real-world 'challenges' for the students to accomplish such as designing a pump for a jet engine. These projects combine practical 'hands-on' learning with the development of technical expertise and are supported by relevant academic knowledge. Lord Baker, who with Lord Dearing is the architect of the UTC concept, summed up this approach as "It's learning German for engineering, not Goethe" (Baker, 2011).

1.2. The Learning and Motivation in Engineering Research Project

The study described here is part of a larger longitudinal project examining learning and motivation in 14-16 year old students studying engineering. The aim of the project is to understand how technical students learn, what affects their motivation and what predicts successful educational and employment outcomes. Due to the large scope of the project only the focus group data for the Year 10 UTC students is reported in this paper.

2. Focus Groups

2.1. Participants

Two UTCs based in the Midlands area of England participated in the study. Two focus groups were held with Year 10 students at each UTC. A total of 49 students aged 14-15 years were interviewed consisting of 38 males and 11 females (see Table 2). This reflects the current predominately male intake at UTCs. The majority of participants were white British, two participants were black British (both female), two participants were Asian (one male, one female) and one participant identified himself as mixed white and Asian ethnicity.

Table 2   Participant characteristics in each focus group.

Group	Male	Female	Total
1: UTC1 a	10	3	13
2: UTC1 b	8	3	11
3: UTC2 a	9	3	12
4: UTC2 b	11	2	13
TOTAL	**38**	**11**	**49**

2.2. Data Collection

Semi-structured interviews were used to explore four main areas of interest:

- reasons for choosing to attend a UTC to study engineering
- experiences of technical education and learning at a UTC
- perceptions of the academic/technical divide
- career aspirations and perceived progression opportunities/intentions.

Open-ended questions such as "*How does your experience of being at a UTC compare with what you expected*" were used to elicit spontaneous descriptions. Responses were explored further by probing questions to gain specific examples. This ensured that concrete answers were obtained rather than generalised, speculative explanations. Each focus group was an hour or less in duration.

2.3. Data Analysis

Each focus group discussion was audio recorded and transcribed. All participants and their parents or guardians gave their informed consent and were informed that their responses would remain confidential. The transcripts were analysed using NVivo software (version 10: QSR, 2012) by the two authors using a social constructivist approach to Grounded Theory (Charmaz, 1995).

3. Findings

There was a large degree of diversity in students' perceptions and experiences both within and between the different groups. However, the analysis identified several common themes that were organised into a model (see Figure 1). This model describes the process of choosing to attend at UTC, the key aspects of the experience of being at a UTC that were identified as being important and the impact that this has on them as students.
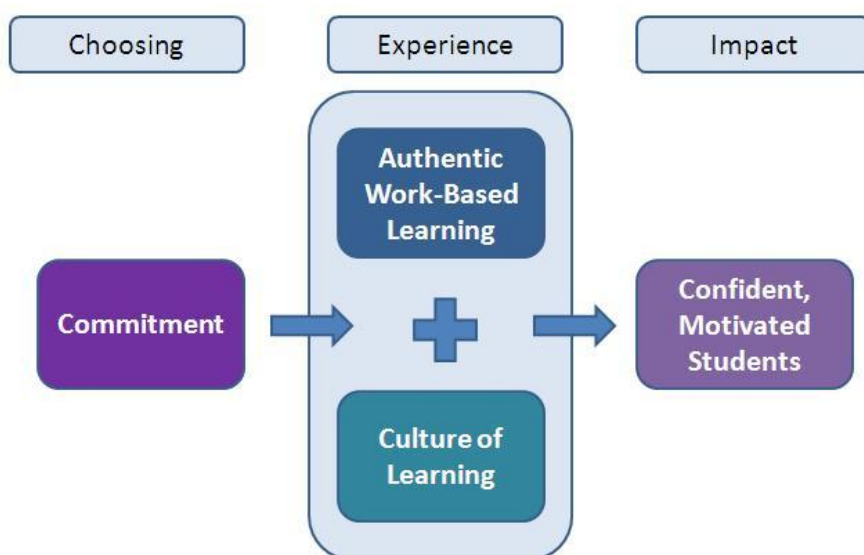
Figure 1   Model illustrating students' perceptions and experiences of attending a UTC.

3.1. Choosing: Commitment

3.1.1.   Interested in engineering

In order to attend a UTC students are required to leave their secondary school at the end of Year 9 when they are 13-14 years old. For the majority of students' their awareness of the UTC was sparked by their interest in engineering.

> *"You wouldn't really come here unless you were interested in, you know, Engineering" – MALE*

The idea of specialising in engineering was perceived as a good opportunity. The facilities at the UTC – specifically its state-of-the-art equipment, links to industry and expert teaching staff – were seen as the ideal environment to study the subject:

> *"I just said that I think it'd be a really good opportunity and I've always wanted to do engineering so I kind of thought this was the best place to go" - FEMALE*

Not all students had any initial interest in engineering or technical 'hands-on learning'. For these students they felt that attending a UTC would give them a 'fresh start':

> *"I used to mess around at my old school like and it's like a fresh start and no-one knows you so you can just start from fresh and hopefully do better" - MALE*

Some students gave the impression that by moving to another school they could reinvent themselves as 'no-one knows you'. They felt that previously they had not been particularly hard-working and had 'messed around' with their friends. At the UTC they would be able to leave behind teacher's perceptions of them as trouble makers. Now they can create a new identity as an industrious student with the hope of achieving more than if they had stayed at their previous school.

By choosing to attend a UTC the students felt that they had made a strong commitment to their education. This would make them 'stand out from the crowd' relative to their friends who remained at their previous school. Their commitment was illustrated by their willingness to adhere to long working hours which many found tiring and atypical holidays that reduced their ability to socialise with friends outside of the UTC. Some students had also given up studying subjects that they had previously enjoyed, such as Art and PE, to specialise in engineering. Nevertheless, the students appeared willing to make these compromises to pursue a technical education. This was not an easy decision to make and many students reported their choice was met with various forms of opposition.

3.1.2. Overcoming obstacles

A few students reported that their decision to move to a UTC had been encouraged by teachers from their previous school. Some reported that their teachers were uninformed or unaware of the UTC in their area. However, many more reported that their teachers responded negatively to their intention to leave to attend a UTC. Some students received dismissive comments suggesting that the quality of the UTC would be so poor they would quickly become disenchanted and return to school:

> *FEMALE: Yeah, the teachers at my old school said it was going to be 'beep'.*
>
> *MALE 1: Yeah, they said it was going to be rubbish.*
>
> *MALE 2: Yeah, they said we'd be back in four weeks.*

Other students reported more personal comments that were upsetting and designed to undermine their choice to attend a UTC:

> *FEMALE: One of the teachers said you're making the biggest mistake of your life.*
>
> *RESEARCHER: So when the teachers were saying this stuff to you, how did that make you feel?*
>
> *FEMALE: Upset.*

Some schools used various ways of actively dissuaded students from leaving. One student said his head teacher told him he had not received high enough grades to attend a UTC. Currently, UTCs do not select their intake according to ability. If they are over-subscribed students within the catchment area are randomly allocated a place[1]. Several students reported that their school refused to allow them to take time off to attend the UTC residential. One student reported that his school moved those who expressed an interest in the UTC to higher ability sets. For some of his peers this tactic was successful as the newly promoted students remained at school.

Students' choice to attend a UTC was also met with opposition from some of their peers and family friends who were unfamiliar with the field of engineering. Some of their peers' were saddened to see their friends leave, while others were more hostile, accusing them of being "too good for us". However, many of the comments were rooted in people's negative stereotypes of engineering:

> *"Well people from my old school used to ask if I was going to come here and build tractors! That's what my friends said to me, 'have fun building tractors'…but they don't actually know what's going on, I think they judge straightaway…" - FEMALE*

The majority of students felt that people held negative views of engineering. They felt that people often underestimated the level of skill required to work in engineering. One student commented that people did not appreciate the 'theory work' involved in engineering. Some students anticipated that they would receive negative comments and so did not tell their teachers or their friends that they were leaving until the last day of term. The decision to go ahead with the move to the UTC despite these negative reactions further demonstrates the students' commitment to attending the UTC even though this meant going against the grain of many people's opinions.

3.1.3.   Supportive family

While students often experienced discouragement and negative reactions to their decision to attend a UTC, almost all of the students reported that their families had been very supportive. Most students felt that their parents (and often grandparents) were encouraging and either supported them in making their own choice or urged them to apply:

> *"My dad was like, it's a good opportunity and it probably won't come along that often and stuff so I, that kinda made me go for it." - FEMALE*

A few students had families with connections to engineering and so they had a more positive view of the subject to counter the negative stereotypes. These students often made references to wanting to work in the same industry as their parents in order to 'make them proud':

> *"Both my parents are engineers so …I kind of wanted to make them proud by trying to get in the family business so I thought I'd take my education at an engineering school." - FEMALE*

The majority of students reported that they would like to pursue a career in engineering and, for these students, studying at a UTC seemed to offer the opportunity to demonstrate that they were strongly committed to this career path. Some students did not want a career in engineering but thought that the UTC route would be attractive to employers and universities

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[1] For example, see paragraph 27 (a) of the JCB Academy's admissions policy.

because it would show them to be highly motivated and give them a unique selling point. Students appeared proud of their commitment to attend a UTC and anticipated that they would be rewarded for their dedication. They also anticipated that engineering professionals and universities would recognise the quality of their education.

3.2. Experience: Authentic work-based learning

The analysis identified two overarching themes regarding students' experiences of studying at a UTC: Authentic work based learning and a culture of learning (detailed in section 3.3). Authentic work based learning consisted of four main themes: Industry links, hands-on learning, teacher expertise, and integrated curriculum.

3.2.1.   Industry links

Representatives from the industrial sponsors visited the UTCs to present the aims of the 'challenges' (see section1.1.) and returned when the project was completed to see the students present their work. Students felt that their experience of studying engineering was greatly enhanced by the involvement of industrial sponsors. Students valued the involvement of employers and were impressed by the authenticity of industrial engagement:

> *"What I like to know is that the school's involved with like loads of companies and it's not like pretend, it's real. Like at other schools, it's just like pretend you're going to do some work for a company but this is real like you're speaking to the manager from a company and it's real life, it's not pretend anymore."* - MALE

The students reported that they were somewhat surprised at the strength of the industry links and welcomed the opportunity to meet high ranking members of staff. The fact that companies were taking the time to be involved in the UTC provided external validation to students' belief that the work they were doing was valued:

> *MALE: I didn't think, I don't think anybody expected the actual people from … like people from companies yes, but not the managing director.*
>
> *FEMALE: Yeah, I wasn't expecting the big people!*
>
> *MALE: The manager of* [Design Company] *just came and sat there and watched us and we're like wow. Obviously if somebody that powerful has given up their time, we must be doing something right.*

The engineering projects were perceived as being meaningful and typical of tasks they would have to undertake in the workplace. They felt that their contact with employers would help them 'get a foot in the door' when seeking an apprenticeship or employment. This was because companies would be familiar with their work and realise that the students had the relevant skills that would be required to work in engineering.

Students had mixed views on giving presentations to industrial representatives. Some disliked giving presentations while others felt that it held them accountable for their progress. Some students felt that being able to speak knowledgeably about engineering to the heads of companies had helped them to develop their self-confidence.

3.2.2. Hands-on learning

All of the students reported enjoying the hands-on workshop sessions. Students preferred to learn in this way and contrasted it with the more passive methods of learning they had experienced in their previous school:

> *"I prefer to be shown and then have a go at it, hands-on but not just being shown by a textbook in a classroom" - MALE*

> *"It's just a different learning environment. It's more hands-on than just sat and working off a board." - MALE*

Many students acknowledged that the smaller class sizes and wider availability of state-of-the-art equipment was a major factor in enhancing their learning during the workshops. Students only complaint was they felt they did not do enough hands-on learning and would prefer more of this activity:

> *"Hands-on more, like we don't do much of those. Like I know there's a certain amount of hands-on you can do but sometimes I'd prefer it if there was a bit more." - MALE*

Students reported that they felt they learnt more in the hands-on workshops as it was more interesting and more relaxed than a regular lesson. They anticipated that the hands-on learning component of the course would provide them with unique skills that would help them 'stand out from the crowd' relative their non-UTC counterparts.

3.2.3. Teacher expertise

The expertise of the teachers and learning mentors was clearly acknowledged as enhancing the delivery of the course content, particularly in the hands-on workshops. Students enjoyed hearing about how the theory and practical skills they had learnt in the classroom were applied in real world settings. They particularly appreciated the way staff went through the tasks thoroughly and in small steps:

> *"The teachers actually know what they're doing. If we're curious about something say like 'housings' they'll go through it in detail with us, how it's used and how you attach it." - MALE*

They valued these enhanced explanations and felt that this type of learning could not be achieved by reading a text book:

> *"They explain it better because they know what they're doing whereas the other teachers were just reading it off a book which is something you could do yourself." - MALE*

Students also welcomed the way the teachers and mentors offered them hints and practical 'tricks of the trade' that went far beyond what they could learn from a textbook:

> *"But with having teachers that have been in the business, you can ask well like 'what would be a tip around getting round this problem' and 'what can I do so when I actually do manufacture it, this doesn't happen' and then they can just explain it a little bit and then you can actually go and .., if they say 'well look up this such and such' then you can look it up and then it'll help you." - MALE*

They felt that staff's expertise was a result of their experience in industry and added to the authenticity of their work-place learning.

3.2.4. Integrated curriculum

A unique aspect of the UTC learning experience is the integrated curriculum. Overall students had positive views of the way the subjects were taught. They felt that the links between the subjects were clearly expressed and that they could apply the more academic aspects of engineering they had learnt in science to help them to understand their practical tasks.

> *"Like in science – you're learning about certain things and then that helps you in engineering… So they all kind of fold into engineering but they all help you in the same way." - MALE*

Conversely, what they had learnt in their workshops gave them a 'real-life' example to help them understand the theoretical concepts they were taught in their more academic subjects. A few students felt that the subjects were disjointed and many students failed to see the relevance of subjects that they perceived as being not directly related to engineering:

> *"I came here to study engineering, not German" - MALE*

A downside of the integrated curriculum seems to be that if the students feel that the subject or activity is not connected to engineering they see little value in participating. For example, many students resented staying 'for an extra hour' (compared to school) to participate in enrichment options. Most students would prefer to have the option of taking enrichment and felt that many activities, such as playing football or watching a film would be more enjoyable to do at home with their friends.

> *MALE 1: I think, I mean, some of the stuff that you do here you could do at home.*
>
> *MALE 2: Like film club?*
>
> *MALE 1: You can watch a film at home.*
>
> *MALE 3: Depends what you do.*
>
> *MALE 4: Because like me, Tom, Dick and Harry, we like do the schools competition (building a remote controlled car) so it's alright because you're actually getting something at the end of the day with it.*

Enrichment was only seen as worthwhile if it related directly to engineering and would be useful experience that could be added to their CV. In the quote above the student participating in the competition values this activity as he is 'actually getting something at the end of the day', possibly a reward if his team win the competition.

3.3. Experience: Culture of learning

The second major theme that described student's experience of studying at a UTC is that there was a strong culture of learning that contrasted with their experiences at their previous school.

3.3.1. Positive relationships with staff

Section 3.2.3 described how students valued the expertise of the teachers and learning mentors at the UTC. This lead to students having greater respect for staff. This was reciprocated as students felt that they were treated more like adults at the UTC than at school. Students felt that staff trusted them more to behave appropriately in class and in the workshops. As a result they were more likely to be trusted to work in teams, something that led to students 'messing about' in their previous school:

> *"Yeah, because you're trusted that you won't mess about. In your old school it was like 'oh you'd best not work in a team'"* - MALE

Students also reported that the UTC staff trusted them to do their work properly and that making mistakes is simply part of the learning experience:

> *"The engineering teachers tell us it's alright to get it wrong".* - MALE

Students reported that if they would have been reprimanded for making a mistake at their previous school:

> *MALE 1: If you say like do an accident like at a normal school the teacher would go ballistic but here it's like they understand it's like an accident and accidents happen.*

In contrast, at the UTC mistakes were used as learning opportunities and staff gave students 'constructive criticism' to enable them to 'get around the problem'.

> *MALE 2: They show you how not to do it next time.*

> *MALE 3: They know that everything's not going to be perfect.*

3.3.2. Learning focused

Students reported that previously at school students would mess around because they *had* to be there, whereas the students at the UTC have chosen to be there - they want to learn. At school students were made to work by the teachers. At the UTC the students motivated themselves and working, not messing around, was the norm:

> *"Whereas the other place* [previous school] *you were made to work, it felt like you were being made to work. Here it's not normal if you don't work if you know what I mean. It's like an all out mentality"* – MALE

Students reported not being able to learn at school as often they were distracted by their peers or by other pupils' disruptive behaviour:

> *"Because when I was in my old school, when you sat down to learn, I really didn't want to because there was no point because I'd just get distracted but at this school I can get on with my work and not get distracted"* – MALE

Some UTC students reported being disruptive in class but they were in the minority. This may be due to selection bias as the UTCs may have only allowed well-behaved students to participate in the focus groups. However, there was a strong sense that disruption in the classroom or workshop was not tolerated by the other students:

> *MALE 1: I'm just starting to mess about in every lesson because if I don't get on with the teacher, I don't see the point in doing the lesson.*

> *MALE 2: Don't you think about anyone else?*

> *MALE 1: If I don't like something …*

> *MALE 3: No. There are other people who want to learn.*

Some students were described as disruptive, but they were a minority and were often challenged about the selfishness of their behaviour by the other students.

3.4. Impact

Students overwhelmingly felt that attending the UTC had a positive impact on their motivation, their approach to learning and their future career prospects.

3.4.1.   Motivated to learn

As has been illustrated in several sections (see 3.1.1, 3.2.4 & 3.3.2), the students generally displayed high levels of motivation. They talked enthusiastically about their work and appeared to be more engaged with their lessons than they were at their previous school. One student described how lessons seemed to drag at their previous school but now they passed quickly. It was 'normal' to be well behaved and motivated to learn:

> *"You wouldn't join if you didn't want to learn" - MALE*

When asked whether their attitude towards learning had changed since they began attending a UTC students often reported the following:

> *"I sort of want to learn a little bit more" - MALE*

Students felt that they had to work harder than in their previous school and their motivation to learn was reflected in the commitment (see section 3.1.) they had made to attend a UTC that had longer hours:

> *"You're not going to come to a school with these hours unless you know you want to do something with engineering" - MALE*

Students often reported seeing opportunities to learn that they may have previously ignored. For example, at their previous school, revising had felt like a chore but now it was perceived as being useful and worthwhile:

> *FEMALE 1: But we have revision which we have to complete but I guess some people would choose not to because they see it as homework but it's like, you know…*
>
> *FEMALE 2: It's just something to help you.*

Their motivation to learn was associated with a range of reflective learning behaviours designed to improve learning outcomes. These are described in the next section.

3.4.2.   Self-regulated learning

Self-regulated learning can be defined as process of accepting responsibility for one's own learning (Zimmerman, 1990). Students who self-regulate take control of and evaluate their own learning and reflect upon and adapt their behaviour accordingly. Opportunities to develop these skills were most often reported during the course of the engineering 'challenges'.

Students described a situation where the teachers and mentors encouraged them to plan their work and take responsibility for their own timetable. They reflected on how they managed their timetables and, with the help of staff, planned ahead for mistakes and tasks taking longer than they had anticipated.

> *"What I like about it, we have projects and we're not told each lesson what we're supposed to do. We're like given a brief and that and then we have to like learn how to manage your time so it's not like you have a lesson …So it's like all organised. We have to like plan everything out…" - MALE*

They talked about learning from their mistakes (see section 3.3.1.) and evaluating any modifications that had been made during the write-up of the project. They evaluated their performance and adapted accordingly:

> *"Showing you can make it, show that you can plan it, you're showing that you can change something once you've done it wrong so it's even better if you've done it wrong really. .. if you have to make alterations"*
> *- MALE*

The students found it useful to be given a clear overview of their project, which was not always made explicit at their previous centres. Specifically, they liked having access to the number of hours that were available for the task (as opposed to the number of weeks or an unspecified amount of time). The nature of the work undertaken in engineering (short 8 week projects) also seemed to lend itself to self-regulation as the relatively short timeframe meant that students had the opportunity to manage a small project that could also be supervised by staff.

There was some evidence of students transferring the planning skills that they learnt in engineering to other subjects. For example, planning for their projects was seen as a useful skill to use for planning during their GCSE controlled assessments when they were unable to ask for help from the teacher. One student described how she had started to transfer her engineering planning skills to other subjects:

> *"…because you have to do it for your (engineering) coursework I suppose then you think I could do that in English or … you think more strategically" - FEMALE*

3.4.3. Confidence

The students felt that attending a UTC would help them to 'stand out from the crowd'. The involvement of companies in the curriculum boosted students' self-esteem (see section 3.2.1.) and students felt confident that they were mastering the skills that they required for the workplace:

> *"If they're partnered with the school and stuff, they know where you've come from and what sort of education you've had. They know that you've got the certain skills that they want." - MALE*

However, students were not over-confident and were aware of the realities of the current economic downturn and its implications for employment:

> *"Coming here will make it easier (to get a job) but it's never gonna be easy really" - MALE*

Students felt that in the six months that they had been at the UTC they had exceeded their expectations of what they thought they could achieve:

> *"You just amaze yourself with what you can do. Then you think 'I'm rubbish at that, at the end of the year I'll probably be able to make a bolt' but then you end up making like something huge and you're like 'oh that's amazing'". - MALE*

> *"Like last year, we just found out about this school, I wouldn't think I'd have been able to do the things I've been able to do". - FEMALE*

4. Concluding comments

Students felt that there were some drawbacks to attending a UTC, such as the longer day that left them feeling tired, the absence of some subjects that they had previously enjoyed, and that participating in extracurricular activities was not optional. However, they felt that these drawbacks were outweighed by the benefits. These were having more opportunities to learn from expert teachers, with state of the art equipment, and doing projects with real-world significance that would prepare them for the workplace. The involvement of industrial sponsors was particularly valued as it would help UTC students 'stand out from the crowd' when applying for jobs and apprenticeships. Having contact with high-ranking staff from companies whilst studying was viewed as helping students 'get a foot in the door' to begin an engineering career.

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