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Why do students choose to study on engineering foundation year programmes within the UK?

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ABSTRACT
In recent years there have been calls to increase both the number and diversity of engineering graduates within the UK. In addition to this, technological advancement and the need to solve complex socio-economic problems, have contributed toward a shift in the skills and abilities that practicing engineers require. Such changes have led to an increased focus on attracting students from a variety of backgrounds, who may want to study engineering for an increasing number of reasons. There is thus an interest in the factors which influence students to apply to study engineering. This paper describes the use of digital storytelling to understand the reasons that 82 engineering foundation year students from one UK-based institution, chose to study engineering. The research makes use of social cognitive career theory. The findings demonstrate the complex way in which environmental contextual factors influence self-efficacy, learning experiences, and career expectations. Based on these findings, some suggestions are made for attracting and retaining engineering students.

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Career choice; widening participation; motivation; engineering education

1. Introduction

The need for engineering students to gain a liberal education has been highlighted since the 1950s (Andrews and Mares 1963; Davies 1966; Grinter 1955; Ministry of Education 1961) and today there is increased emphasis on the broadening of engineering curricula. In the UK, the Royal Academy of Engineers present a model which 'places engineering into a contextual framework that demands an approach that is holistic and transdisciplinary', which they say is 'vital for the development of future orientated, sustainable, and socially responsible engineers' (RAEng 2018). Elsewhere, the Institution of Engineering and Technology (2019) have suggested six ways in which to address the shortage of engineers which includes: incorporating creativity in engineering; broadening the diversity of students; a strong emphasis on project work; industry engagement in design and delivery; experience of the workplace; and greater interdisciplinary. They also acknowledge that the requirement to have studied 'hard' disciplines such as mathematics and physics, restricts access to the engineering, and several institutions within the UK no longer require mathematics as a post 16 qualification to study engineering (Graham 2018; IET 2019). These views are, to some degree, reflected in the changing messages shared during marketing and outreach campaigns which aim to attract students into engineering. It is therefore not unimaginable that engineers will increasingly be attracted into engineering for a greater number of reasons and bring with them a variety of different expertise and experiences.

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The recruitment of more engineering students is not only beneficial to the profession. For example, in a recent report about how the study of engineering can help to solve the problem of social injustice, the Engineering Professors Council (2021) found that engineering students at all levels of prior attainment earn higher wages than the average for other subjects and that those with lower attainment experience the greatest added value. Their recommendations included expansion of foundation year (FY) courses and conversion courses.

This paper describes the use of digital storytelling to understand the reasons that 82 engineering FY students from one UK-based institution, chose to study engineering. The research makes use of social cognitive career theory (SCCT) to try and understand the way in which environmental contextual factors influence self-efficacy, learning experiences, and career expectations.

The remainder of the introduction will include a summary of theories of career choice, discussion of previous research that focuses on the motivations of engineering students, the role of FY programmes within the UK, as well as an introduction to digital storytelling.

1.1 *Career choice theories*

Several different theories have been used to try to explain the factors involved in career choice. Expectancy value theory considers competence and value beliefs, which can be used to help explain the choice to pursue a particular course or occupation. It 'focuses on the social psychological reasons for people's choices in achievement settings; thus, expectancy and value are defined as cognitive rather than purely motivational constructs' (Wigfield and Eccles 1992, 278). Such beliefs can be informed by past experiences, socialisers, and personal and collective identity beliefs. Competence beliefs are defined as expectancies of success meaning how well students believe they will perform in an activity, and are linked to self-efficacy beliefs. Value beliefs are split into four categories: (1) attainment value; (2) intrinsic or interest value; (3) utility value and (4) relative cost (Eccles 2005; Wigfield and Eccles 1992).

A different theory, SCCT aims to explain the way in which educational and career choices are made (Lent, Brown, and Hackett 1994). The theory (see Figure 1 for a schematic) links three variables: self-efficacy beliefs (which are specific to particular activities and derived from personal accomplishments, vicarious learning, social persuasion, and physiological and emotional states); outcome expectations (which relate to beliefs about the consequence of an action); and choice goals (the

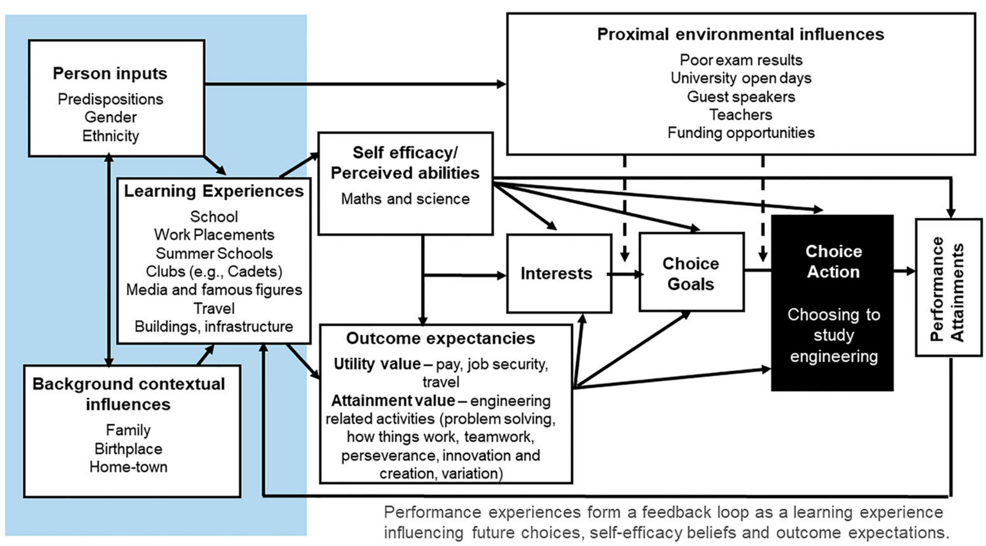

Figure 1. Social cognitive career theory choice model (Adapted from Lent, Brown, and Hackett 1994) showing themes identified from the data.

intention to engage in a particular activity). Career related interests are then formed through self-efficacy and outcome expectations and promote educational and occupational choice goals. The model also recognises that interests are most likely to have an influence on career choice in the case that supportive environmental conditions exist, and that certain barriers such as finances or family commitments, may result in a compromise in interests. Within the model, contextual influences are either referred to as 'background' or 'proximal', the former influencing learning experiences and therefore self-efficacy and outcome expectations, and the latter referring to support or barriers during active choice making. One of the fundamental features of the SCCT model of choice is that it includes reference to person input (including ethnicity and gender) and contextual factors. Person inputs are characteristics which vary between individuals and may include socially and culturally defined factors. Examples include personality, gender, ethnicity. Like expectancy value theory, SCCT includes consideration for 'values' which are included as outcome expectations whereby value on an anticipated outcome drives interest in an activity (Lent, Brown, and Hackett 1994).

Such theories have been used to explain the decisions made by those studying engineering. For example, during a study into the how likely student were to persist in their study of engineering, Godwin and Kirn (2020) made use of future-time perspective (FTP) theories, a human motivational theory, to demonstrate the connections between students' engineering role identity and domain-specific constructs. They suggest that educators support the development of individual's engineering identity by providing authentic engineering tasks, supporting the exploration of interests in engineering, and recognise students as engineers (Godwin et al. 2016; Godwin et al. 2018).

Matusovich, Streveler, and Miller (2010) used Eccles' expectancy value theory, to understand how students' engineering-related value beliefs influence their choice to study engineering degrees. They primarily focused on the subjective task value (STV) construct, the incentive for engaging in a task/activity based on how well its nature is aligned with personal values, goals, and needs (Eccles 2005; Eccles et al. 1983). They found that students' values play an important role in their choice to become an engineer. Jones et al. (2010) used a survey instrument to obtain data pertaining to expectancy and value-related beliefs of first year engineering students. They found that expectancy-related constructs predicted achievement better than the value-related constructs, which better predicted career plans.

Painter, Snyder, and Ralston (2017) make reference to SCCT during a qualitative study into what influenced 390 students to study engineering. The top three reasons reported were 'expressing an interest in the subject matter, being influenced by family, and prior experience with engineering-related activities'.

Other studies have compared the differences between the reasons that men and women study engineering. For example, data from a UK based, cross-faculty survey was used to show that motivation varies over time, with students starting an engineering degree being more likely to aspire to 'invent something new' (stronger for males) and 'make a difference to the world' (stronger for females), whilst final year students were more likely to focus on financial security. Data from the same study showed that over one quarter of UK students who participated in a cross-faculty survey also reported being influenced by their parents, with more than half having a parent from a background related to STEM subjects (Alpay et al. 2008). Similarly, in a survey of students from 50 institutions within the USA, Godwin, Klotz Hazari and Potvin (2016) found 'contributing to future sustainability' to be a motivating factor for female students and other minority groups within engineering.

Another study identified five factors as being most influential to students in choosing engineering: intrinsic psychological and behavioural motivation, (extrinsic) motivation related to the social good, financial motivation, mentor influence, and parental influence (Atman et al. 2010; Sheppard et al. 2010). For male students, behavioural motivation played the largest role, with mentor motivation being most important for female participants.

Different work has highlighted the role that motivational factors play in persistence and retention, something which is of particular interest when considering the retention of FY students. Eris et al.

(2010) showed that motivational factors impact on students' persistence in completing their degree, as well as initial choice, and Seymour and Hewitt (1997) claim that intrinsic interest must be present, either in combination or isolation with other reasons, for students to persist within STEM subjects.

In this work, SCCT is used to understand the complex ways in which interests and contextual influences influence learning experiences, self-efficacy, and outcomes and thus career choice This is considered as a useful framework for a study which involves students from a variety of different backgrounds and who may have encountered barriers to studying engineering, as is explained in the next section.

1.2. UK foundation year programmes

Integrated FY programmes are typically offered to those entering UK higher education institutions (HEI) without meeting the traditionally accepted entrance requirements and are thus designed to help develop the skills and knowledge necessary for progression into the first year of a traditional degree scheme. Some FY students may therefore be considered 'non-traditional', for example mature, first-generation, part-time, entering via vocational routes (Dodgson and Whitham 2004) or low achievers (Peasgood 2003). Many may have faced 'dispositional' or 'situational' barriers to success (Harrison 1993) and FY schemes can play a vital role in supporting students during transition into higher education (Levy and Murray 2005) as well as in student retention (NAO 2007; Smith and Naylor 2001; Webb, Wyness, and Cotton 2017).

FYs are thought to help widen access and participation, particularly for underrepresented groups, and their availability is therefore considered to be driven by egalitarian motivations (Austen, Pickering, and Judge 2020). However, in recent years, changes to the way in which HE is funded has resulted in increased levels of competition between institutions, who are introducing and expanding their FY offering with the aiming of generating revenue (Austen, Pickering, and Judge 2020). The number of students entering integrated FY programmes almost tripled between 2012–2013 and 2017–2018 (Finlayson 2019).

Within the UK, the establishment of FY programmes within engineering disciplines are becoming increasingly popular, this being, in part, driven by the current shortfall in engineering graduates, something which is compounded by low participation of women (Engineering UK 2020). In comparison to traditional engineering degrees schemes, which often expect high levels of achievement within mathematics and the sciences, the students enrolled on engineering FY programmes typically enter with varying levels of qualification: low grades in science A-Levels (the qualifications offered at age 16 which typically lead to university within the UK); A-Levels in non-scientific subjects; vocational qualifications (including Business and Technology Education Council qualifications or BTECs); or without any formal qualifications.

This mismatch between FY students' qualifications, and those required to enrol on the first year of engineering schemes can occur for several reasons. For example, within the UK, interest in science has been shown to decrease by the age of 10–11(Murphy and Beggs 2005), with an interest in science being formed by age 14 (Archer et al. 2013; Lindahl 2007; Ormerod and Duckworth 1975; The Royal Society 2006; Tai et al. 2006). These findings suggest that the majority of students form their career aspirations before the point at which it is necessary for them to select the subjects they will study at the end of secondary school (aged 14–18). It is therefore clear that students who show interest in engineering at a later stage, may have already chosen not to study subjects that would make them eligible for study on the first year of an engineering degree.

Previous attainment within a subject is also a significant factor in determining future study choices. For example, students with low to mid attainment levels in mathematics at GCSE are reluctant to study the subject at A-Level, and are inclined to study different subjects in which they are more likely to achieve higher grades (Jackson et al. 2007).

Students studying engineering FY courses may therefore be considered unconventional in that they could either have decided that they wanted to (1) study engineering after choosing their A-

Level subjects or (2) continue in their journey towards becoming an engineer despite low attainment in STEM-based subjects.

1.3. Digital storytelling

Digital storytelling typically involves the creation of personal narrative in the form of short (3–5 minutes) movies which may feature images, sound, video, narration, presentations, or other forms of media (McLellan 2007) and has its roots in the work of Dana Atchley and Joe Lambert who founded the StoryCenter in 1993 (McLellan 2007).

The value of digital storytelling has been acknowledged within HE, with educators recognising its ability to help students in developing skills in digital literacy (Chan, Churchill, and Chiu 2017) and creativity, whilst also providing them with the opportunity to become more self-aware. Previous research into the use of digital storytelling within HE has focused on the role it plays in student engagement and deep learning (Ryan and Aasetre 2021), and encouraging student reflection (Long and Hall 2017), self-development (Ribeiro 2017) and intercultural awareness (Ribeiro 2016).

Austen, Pickering, and Judge (2020), who made use of digital storytelling to explore the experiences of students during transition onto an Integrated FY in Art and Design at one UK HEI, describe the way in which digital storytelling can be used to 'amplify hidden or marginalized voices' (3), and highlight the work of Hopkins and Ryan (2014) which focused on digital stories created by undergraduate students from low socioeconomic backgrounds.

In this work, we make use of digital storytelling to gain a deeper understanding of the reasons that students have chosen to study on an engineering FY programme. Digital storytelling has been highlighted as a means by which to record 'your own desires in life, the kinds of struggles you have faced' (Austen, Pickering, and Judge (2020), 21) and is therefore deemed an appropriate method by which to obtain insights into the factors that have encouraged students to study, and which are, as yet, unknown to the educators teaching them.

In this work, the digital stories analysed were produced by students enrolled on an engineering FY programme, as part of a 10-credit professional skills module and constituted 15% of the module mark. Digital storytelling has previously been suggested as a form of inclusive assessment (Jenkins and Gravestock 2012, 131) that can be used as an alternative to written work, providing an 'opportunity to discuss personal issues in a way which they may not do so readily in a traditional essay or report' (Jenkins and Gravestock 2012, 131). This is particularly relevant given the relationship between assessment format and levels of student experience and engagement (George et al. 2004), confidence and motivation (Mentkowski 2006), and the way in which assessment can act as a barrier to widening participation (Ertl, Hayward, and Hoelscher 2009; Francis 2006; Hatt and Baxter 2003; Hoelscher et al. 2008; Hounsell 2007; Hudson 2005; Leathwood 2005; Leathwood and Hutchings 2003; Payne 2003).

Although research has previously focused on the reasons for studying engineering, primarily within the USA, little work has made use of a qualitative approach or focused on those who enter FY programmes. It is believed that the use of digital storytelling will allow students to reflect on their reasons honestly and to demonstrate their creativity. If we are trying to encourage a greater diversity of students into engineering, then it would seem logical to focus on the motivation of students entering engineering via untraditional routes and who are likely to have the biggest variance in prior experience, attainment, and motivations. Such findings may be used to inform and support recruitment and ways in which engineering may be promoted to those who have not considered it before reaching the end of secondary education, and in motivating and encouraging those who have low confidence in their ability in STEM subjects. It is also anticipated that understanding the motivations will provide insight into approaches to tackle other issues, for example, progression and retention. The use of an open-ended question allows students to consider why they have chosen to study engineering, without being aware of preexisting notions. It is believed that this will enhance understanding about whether students' motivations are influenced by emerging societal issues and the focus on the changing role of engineers.

2. Methodology

Students were asked to produce a 4–5-minute digital story entitled 'Why I am studying engineering' as an assignment for a 10-credit 'Development of Key Skills for Engineers' module. The module ran in the first semester of the academic year, for a duration of ten weeks from late September to early December 2018. The syllabus included: identification and assessment of key skills; oral communication (planning, preparation, and presentation, resources, use of slideshow software and videos for communicating ideas); written communication (report writing, information gathering, structure, and content); ICT skills (introduction to computing using MATLAB); graphical communication (orthographic projection, isometric projection, sketching); project work (structure of the project, planning and organisation, brainstorming, review of progress); and networking skills. There were 2 hours of contact time per week which included lectures, example classes and computer labs. The assignment was introduced half-way through the module and was worth 15% of the module mark. Students were introduced to various types of multimedia software which they may utilise to complete their assignment. Although they were asked to include use of slideshow presentation software, they were given a significant degree of flexibility in the format of the submission. They were informed that their submissions would be marked according to the following criteria: video length (between 4 and 5 minutes); their physical presence within the video; the structure of the presentation; quality of content (on topic) text and graphics; quality of production.

The presentation assignment had been included in the module for several years. However, this is the first time that it was considered as a source of research data. As such, approval to use digital stories for research purposes was sought from the Swansea University College of Engineering Ethics Committee. Once students had received their grades, they were asked to give permission for their digital stories to be used for research purposes. Students were provided with the research information sheet and asked to 'opt out' if they did not wish for their assignment submission to be analyzed as part of the research.

Although, the use of retrospective permission limits observer effect, the use of students' digital stories as research data is recognised as an ethical concern that, following Joan Tronto's Ethic of Care approach (Tronto 1993, 2001), 'cannot be contained in codes of conduct alone and cannot simply be signed off on by institutional review boards, but is rather a matter of a daily personal, professional and political caring practice' (Gachago and Livingston 2020, 1). For this reason, any data that was regarded as sensitive, or considered to pose a threat to student anonymity, was removed prior to analysis.

A thematic analysis was undertaken according to the procedure outlined by Braun and Clarke (2006), with an initially inductive and semantic approach taken to identify themes. The author watched all digital stories and transcribed the audio. Due to the number of different modes of communication (verbal, visual and auditory) exhibited in the stories, details pertaining to use of visuals and text were also recorded. The data was coded to identify themes and sub-themes. Following the analytical approach described in previous work by Austen, Pickering, and Judge (2020) Hull and Nelson (2005), little attention was given to background music.

The digital stories were viewed again (in some cases multiple times) following theme identification. Although the data were only coded by the author, to enhance the credibility of the findings (Guba and Lincoln 1989, 237), themes were compared with patterns and trends identified by the module coordinator, who had watched all the videos during the marking process.

Prior to data analysis, the author conducted an exercise to surface their interpretative lens, and a summary is shared to inform the interpretation of the data presented. The author is interested in the ways in which the engineering profession can contribute toward systems of injustice. Although she has always shown an interest in issues of inclusivity, she considers herself as a traditional and academically successful student. It was only when she enrolled on a teaching qualification programme and began to teach FY students that she began to take a more wholesome view and adopt Ainscow's (1999) approach to inclusive education which involves consideration for 'barrier (s) to participation … experienced by *any* pupils' (218).

The author also recorded any biases they held regarding reasons for the selection of an engineering major and retention, a process that is recommended to ensure trustworthiness during qualitative research (Creswell 2013). She expected students to mention self-efficacy in mathematics and sciences, an enjoyment for practical work and a desire to earn a comfortable income.

3. Findings

Eighty two submissions were analysed. Table 1 shows the sample characteristics to be representative of the population with respect to both gender and chosen discipline.

The majority of the sample were British (70 of 82) and aged between 18 and 21 (80 of 82), with one being 27 and one 31 years old. Further details pertaining to the prior attainment of the sample are provided in Table 2. Half of the students had obtained an A-Level in Mathematics, the majority at grade D and below. 16 of the 82 students had A-Levels (not including Mathematics), with the remaining students having BTECs or overseas equivalent qualifications. One student did not have any post 16 qualifications. Participation of local areas (POLAR) classification groups, which classify and rank local areas across the UK according to young participation rate in higher education (with quintile 1 having the lowest participation rates and quintile 5 having the highest) are shown in Table 3. Students were fairly evenly distributed across groups 2–4. Approximately 10% of students (8) were from a low participation neighbourhood, this being consistent with the average for the university.

In some cases, the stories were prescriptive in nature and included a list of reasons to study engineering that may be similar to those found on a website that provides career advice, or by doing an internet search. However, many students provided personal anecdotes and reflected upon their experiences including where they were from, their schooling and travelling experiences. The format of submissions varied and included: slides with voiceover; videos of students making a presentation; a mixture of slides interweaved with stock images, personal images, video clips, sounds and music, and animation. The nature by which students created and shaped their own submission indicates ownership of the process.

The title provided to students meant that they were not limited in what they spoke about, which perhaps meant that they were more willing to share the reasons that they felt best explained their reasons for studying engineering. The levels of authenticity associated with submissions is perhaps made most evident by one student who said that they felt a need to 'go back to the personal statement kind of mode where you talk about how … this career path has influenced you since you were a child or how you've always been passionate about this career path' but then added that they didn't 'feel that answering the question in that way portrays an honest answer' as they felt that the question was asking 'who is the person, the individual'.

Table 1. Sample and Population characteristics.

		Population ($N = 277$)	Sample($N = 82$)
Gender	M	83%	82%
	F	17%	18%
Discipline	Aerospace	26%	30%
	Chemical	16%	13%
	Civil	13%	15%
	Electrical and Electronic	10%	9%
	Materials	3%	2%
	Mechanical	22%	15%
	Medical	7%	15%
	Unconfirmed	3%	1%

Table 2. Prior attainment of sample.

Prior Qualifications	Number of Students	Mathematics Grade	Number of Students
A-Levels (of which one was mathematics)	42	B	1
		C	5
		D	28
		E	12
		U	2
A-Levels (of which one was not mathematics)	16		
Mixture of A-Levels and BTEC	3		
BTEC Engineering	7		
BTEC (Non-engineering)	4		
Overseas Equivalent Qualification	3		
No post age 16 education	1		

As explained previously, FY students often enter HE via a variety of different routes and many students spoke about the contextual factors which influenced their decisions. For this reason, SCCT was used during the analysis of the data, with the 'choice action' referring to the choice to study engineering. Some effort has been made to quantify the occurrence of each theme. However, as the aim of this research was to understand the complex ways in which career decisions are informed, a (relatively) small sample size (~82) was used meaning that quantitative findings are associated with limited validity.

The complex way in which the different building blocks of the SCCT model are linked together, means that it was difficult to divide the findings into sections according to the theory. Instead, the role that each identified theme plays in the model is described, alongside the influence the theme has on other parts of the model. Themes are generally ordered from left to right of the SCCT model (Figure 1), starting with 'person input' and finishing with 'choice action'.

3.1 Gender

Gender can be understood as a 'person input' which moderates the role of background contextual influences, socialisation processes, and learning experiences.

Perhaps unsurprisingly, given the fact that these women had chosen to study engineering, did any of the participants relate their gender to a lack of self-efficacy. However, 4 of the 15 female participants gave explicit reference to their gender and the role it had played in their aspirations.

The findings appear to suggest that female students felt a pressure to choose engineering in order to prove themselves with one saying, 'I feel like I'm proving to people that anyone can be an engineer if you set your mind to it, irrespective and regardless of gender'. Participants generally seemed to accept adversity as an inevitability of being a woman in engineering, with one student saying that she felt the need to 'stand my ground and stay in engineering despite all hardships that may arise'. They appeared to believe that any setbacks should be combatted by working harder, with one participant stating that 'engineering is no easy task' and another that she wanted to 'work even harder to show that any female from any background can dream and fulfill those dreams'.

Table 3. POLAR4 data for sample (based on home postcode).

Quintile	Number of Students
1	8
2	16
3	19
4	16
5	20
Not Available	3

It was clear that gender had mediated the role that background contextual influences and learning experiences had played in shaping how participants viewed the engineering profession. One student mentioned that she had attended an

> academic all-girls sixth form which focused on pushing us to do the best we possibly could … 20 out of the 90 girls in my year took physics from which we were taken on multiple school trips to encourage us into a STEM career.

Two different women highlighted the part played by role models, with one highlighting the importance of 'many female role models around me who have aspired to be things that aren't seen as a normal things that females would do' and another describing her aunties, who were engineers, as 'extreme inspirations'.

These findings are consistent with those of Powell, Dainty, and Bagilhole (2012) who described the contradictory views that can be held by female engineers who maintain stereotypes about women's suitability for engineering work, whilst also believing that the career path is available to those who wish to take it, 'if only she were interested in the subject' (Powell, Dainty, and Bagilhole 2010, 577). Elsewhere, both Rich (2005) and Budgeon (2001) claim that the views that women hold about equality can result in a feeling of distain for those who fail in areas where they themselves have succeeded. These views draw parallels with the work of Seron, Sibley, Cech and Rubineau (2018) who described the way in which women embrace values of meritocracy and individualism despite experiencing sexism. The authors conclude their work by claiming that engineering education acts to transform 'potential critics into agents of cultural reproduction' (131).

The findings highlight the role of socialisation within engineering culture and demonstrate a need for a deeper understanding of the ways in which advancing equality within engineering relies on critique and collective action. They also raise further questions about the way in which female students are affected by both pressures to study engineering, as well as engineering values and culture.

3.2. Family

Almost half of the participants mentioned the influence of family members, this being unsurprising given the wealth of evidence available regarding the role that family plays in students' STEM aspirations (e.g. Aschbacher, Li, and Roth 2010; Barnard et al. 2010; Dick and Rallis 1991; Ferry, Fouad, and Smith 2000; Gill et al. 2008b; Gilmartin, Li, and Aschbacher 2006; Jawitz and Case 1998; Johnson and Stewart 1997; Stake 2006).

In accordance with the work of Dias (2011), the father figure was referred to in the majority of instances, but grandfathers and brothers also played a role in the decisions of some students. A maternal influence was mentioned by only one participant whose mother was an engineer. Family members were primarily involved in participants' learning experiences and vicarious learning and appeared to result in increased self-efficacy.

Some students considered that simply having family members who worked within engineering encouraged them to pursue an engineering degree with one saying, 'it's all I've ever known' and others that they were 'easily influenced by engineering' and 'I was a sponge to influences like my father'. One student considered that being 'surrounded by engineering my whole life' meant that they knew 'what it consists of … what I need to do to be good at engineering'. Another student described a more active involvement whereby their father, a civil engineer, 'push(ed) me into the scientific side into the engineering through my A-levels'.

Family members were also referred to in the context of outcome expectancies, with some students explaining that they had respect for specific achievements that family members had achieved as engineers, with one saying, 'I always looked up to my father in admiration as during his ongoing career he has had big contributions and important projects' and that he also 'provided his family with a comfortable lifestyle which is something I want to be able to do for my children'. Others spoke of the role their grandfathers played in engineering history. One student wanted to make their family proud and alluded to their dad who 'was the first engineer in his local area', this was 'amazing considering he had close to no resources'. The same participant mentioned being the 5th engineer in their family and carrying 'on with the engineering legacy'. Some students focused on the opinions that family members held, as opposed to their occupations. One said that their 'dad always tells me this is the best type of engineering for the future' and another that 'it sounds cool' to tell family members they are studying engineering.

One student described the role of ethnicity and culture saying that 'my choice to become an engineer is largely due to my family an ethnic background … there is an ongoing stereotype surrounding Asians, that they all aspire to become an engineer or a doctor'. They considered that this 'may seem offensive' but that 'stereotypes … they are based on nuggets of truth'. They concluded by saying 'my parents pushing me for a degree in a similar field is arguably the biggest reason for wanting to do engineering'. This finding is consistent with previous work that shows that the influence that family has varies according to ethnic group (Huang, Taddese, and Walter 2000; Gilmartin, Li, and Aschbacher 2006).

In comparison, one student noted that they 'don't know any friends or family that are doing or have done engineering, so this is a very different path for me in school'.

3.3. Birthplace and hometown

Two participants spoke explicitly of the way in which the place they grew up influenced their decisions, with one student saying, 'I will be talking about the place where I grew up and how it impacted on how I saw the world'. A different student acknowledged that 'the views of a female engineer resulted in a lot of people raising their eyebrows' in the town that she grew up, something which they said resulted in a desire to 'work even harder', this demonstrating the complex way in which gender (person input), background contextual influences and self-efficacy interrelate. In comparison, one student who said that they came from 'a small rural place' where 'there is not much engineering around locally and most people just end up working on the high streets' believed that was why they 'never really considered engineering as a degree option' and had chosen 'to do all the wrong A-Levels'.

3.4. School-based leaning experiences

School-based learning experiences were described as a source of self-efficacy and outcome expectancies with 36% (40% of female students, 26% of male students) of students alluding to enjoying mathematics and science subjects. Such findings are consistent with those of Gill et al. (2008a) who found that ability in mathematics and science was more likely to be cited by women as a reason to study engineering, than by men.

One student said that her experimental results were often 'bang on their predicted answer'. She considered that she did not 'make any mistakes' meaning that she was a 'natural born scientist' and 'suited to a career in STEM and so engineering'.

A different student spoke of the 'sense of achievement' they felt when 'you do a formula, an equation or whatever … especially if you find something difficult'. The same individual said that they liked the fact there was just 'one answer' and appreciated that 'you can see and clearly know the progress you've made from improving'. Students described the reassurance they felt by knowing that engineering would include mathematics and sciences, which they already knew they enjoyed doing, with one student saying 'it's something I could take solace in knowing … I do (it) very easily so I knew that my future career had to include mathematics'. A different student commented that 'I can then put these skills into engineering quite easily … and makes engineering just a very solid choice for me'.

These findings highlight the security associated with the belief that students enjoy, and are successful in subjects, which fall within the discipline of engineering. However, the positivistic way in which students speak of these subjects may suggest a discomfort with more complex and authentic engineering problems, and engineering educators should consider the ways in which they may help students to overcome such feelings. These findings draw parallels to the work of Cruz and Kellam (2018), who attribute students' affinity toward engineering to interest in mathematics and science. As is the case in the current study, they found that students failed to describe the ways in which mathematics is used within the discipline. They continue to warn that some students may have a reductive view of engineering and a limited perspective of what is involved in engineering practice, this posing a risk to retention and progression. Such findings may suggest the need for inclusion of applied mathematics, or more information regarding the nature of engineering work prior to university education.

11 male and 2 female participants mentioned enjoying design work, with one student saying it made them realise they 'want to design more and make more things that would be used just by everyone'. A different student demonstrated how this learning experience had influenced their self-efficacy by saying they 'excelled in design and more technological subjects including graphic design and design technology'.

3.5. Extracurricular learning experiences

Eleven of the 82 students described learning experiences during which they were exposed to engineers and engineering. These experiences took a variety of formats, with one student attending an 'engineering summer school' and other being members of 'STEM club' and 'gifted and talented' programmes. Two female aerospace engineers cited their membership of cadets as one of the reasons they wanted to study engineering.

The role that these learning experiences played in influencing outcome expectancies and self-efficacy was made clear on several occasions. One participant who had completed work experience said that it had given them 'a good view of the fields' and that it allowed them to become 'familiarized with the subject' and gain 'a good grasp of becoming an engineer'. Two students' prior education had been within specialist technical colleges, with one saying that this meant they had 'exclusive opportunities' and were able to visit many engineering firms to see 'how these companies operated and the types of projects they were working on' which they considered had 'bolstered my enthusiasm to the subject'. A different participant spoke of their involvement in educational outreach activities and being 'very enthusiastic about doing experiments and fixing things and this is one reason why I chose to become an engineer'.

3.6. Outcome expectancies

Students primarily described reasons for pursuing engineering that related to: being the type of person an engineer is, in this work referred to as 'attainment value' (Matusovich, Streveler, and Miller 2010); enjoyment experienced doing engineering activities or the thought of doing them, referred to as 'interest value' (Matusovich, Streveler, and Miller 2010); and the usefulness of studying engineering, referred to as 'utility value' (Matusovich, Streveler, and Miller 2010). Table 4 presents representative excerpts organised by interpretive theme, alongside the percentage of students for whom this code was identified.

Outcome expectancies were linked to other concepts within SCCT in various ways. Some of the key findings are summarised below.

- The theme 'how things work/ how to fix things' was inextricably mentioned in relation to hobbies and learning experiences within the home, often in the presence of parents (predominantly

Table 4. Representative excerpts organised by outcome expectancy interpretive theme, alongside the percentage of students for whom this code was identified.

Code	Sub-code	Percentage of students
Attainment value	How things work	35%
'I used to go and just tinker and dismantle certain things … you know I just wanted to see what makes it work'. '*I've always been interested in how things worked … what they were designed for … how they were designed like why they're the best for that situation or the job that they've specifically been designed to do'.*		
Attainment value	Problem solving	24%
'An engineer's job is to solve a problem using a wide range of possibilities'. '*Problem solving first attracted me to the engineering world'*		
Attainment value	Innovation and creation	11%
I *'strive for any innovation'.* engineers *'never just do what has already been established, they always look forward to their future'.* '*Responsible for crafting this utopia'.* '*At the forefront of making dreams reality'.* '*Part of an innovation or invention which will make the world a better place'.*		
Attainment value	Variation	28%
'it's never going to get boring … it's a constantly changing environment'. Application of *'degree to many fields … broaden my horizon … and won't tie me down to one thing'.* Not *'stuck in an office all day and doing monotonous tasks … look forward to doing something new every day'.* *'If I were to not like a part of it … I'll be able to swap'.* '*Intersection point from which a wide range of different disciplines are trying to achieve tangible result'.* ' *… allow me to not necessarily specialize but to learn about and explore other parts of engineering fields and which interact with fields of my other interests'.* Engineering could be *'psychologists analyzing mindset of people, how they work, how they interact with our products and services … we're entrepreneurs we're making it viable in the long run, we're linguists we have to know all the computer codes, computer languages and last not least we're designers we value functionality and the ease of use'.* '*Open a lot of doors'.*		
Attainment Value	Perseverance	30%
'Very challenging'. '*A very hard subject'.* '*No law of physics will prevent us so anyone can become an engineer if they put the heart into it'* '*Adversities and problems along the way helped (me) develop as a scientist'.* The fact that it is *'not easy to do … makes me work harder'* '(I) enjoy *working under pressure'.* '*Failures aren't necessarily bad … failures are what builds up success and with failures you get to learn more than you ever thought possible compared to just managing to succeed'.* '*Continuously developing new skills not just academically but in general … (I) never want to really stop learning and engineering is something that will provide quite an opportunity to learn'.*		
Attainment Value	Teamwork	10%
'Engineering can be a very social thing if you want it to be'. '*each other's strengths … supporting each other's weaknesses for the best result'* '*A great way to meet new people'.* '*Love the idea of many people coming together to achieve one common goal'.*		
Attainment Value	Work towards sustainability	21%
'I believe that one day I will be able to contribute to securing and contributing that future for many upcoming generations'. '*Create a better, more sustainable future for the next generation'.* '*One of the most important roles in combatting issues like climate change'.*		
Attainment Value	Work towards social justice	16%
'From a young age I have always known I wanted to go into a job aiming to improve the quality of life for vulnerable people across the globe'.		
Attainment Value	Serving society	41%
'Provide a very important service to us'. '*A valuable member of your society'.* '*At the front of improving lives'.* '*Laptops, phones and robotics as they are useful and powerful tools which are extremely helpful in today's modern society and increased quality of life for the whole of humanity'.'Loved just finding out how different products and advances in technology have allowed people to have better lives overall and how much of a positive impact engineering meets compared to many other fields'.* '*Obviously technology made the world a better place to live'.* '*(If) it wasn't for engineers then humanity wouldn't have progressed as far as it has'.*		

(*Continued*)

Table 4. Continued.

Code	Sub-code	Percentage of students
Attainment Value	Status and Legacy	18%
'So important … it affects everyone' *'Well respected'.* *'Regard (held for) chartered and incorporated engineers'.* *'Legacy and fame for being a great engineer is close to him by the buildings and projects he did'.* *'Engineering surpasses most other careers as generations from now people will still benefit from the work you have done'.* *'Hopefully I can have the building I designed for all to see long after I'm gone … would be a really achievement for me' 'Reflect on my life when I grow old and think and be proud of what I accomplished'.* *'Make a name … to be known and remembered by world for some great idea'.'Have a workshop or firm and be in charge of something because I really enjoy being lead'.* *'Become someone important'.* *'A steppingstone to becoming a CEO'* *'Impressing people for generations … (don't) want to live a mediocre life'.* *'Come up with new inventions which are the spark of many generations down the line'.*		
Utility value	Pay	22%
'Higher than many other well-respected professions'. *'Extremely lucrative'* *'Who doesn't love money'.* *'Won't have to struggle with money'.* *'A comfortable lifestyle … something I want to be able to do for my children'.*		
Utility value	Job Stability	30%
'Endless job opportunities for a new graduate'. *'There'll be jobs waiting for me'* *'There's always going to be a need for engineers … it's something that is, you know, it's always required'.* Global demand for *'engineering manpower'.* *'Main reason I chose'* engineering. *'Stable and reliable career'.* *'Stable platform for many careers … the skills that you acquire through studying and practicing engineering are highly valuable and transferable'.*		
Utility value	Opportunities to travel	18%
'All countries require engineers in order for them to develop'. *'Traveling is a hobby of mine … visiting new places and getting to know new cultures help in building a better character'.* *'Have some fun at the same time as working abroad'.* *'Love to have the opportunity to work overseas and be able to experience those cultures permanently with my family'.* *'Be much easier for me to actually go somewhere … limitless'.* *'Top companies are usually willing to pay for a degree engineer to get them out there to work for them'.*		
Interest value	Happiness and enjoyment	13%
'Doing a job that makes you happy in life is essential as you'll be stuck with this job for the rest of your life'. If we *'truly enjoy the work we do, it drives us to continue this work, if not for the better this of oneself than for the sheer enjoyment of it'.* I *'fully believe that if you do something you enjoy as a job, you'll never have to work a day in your life and I'm also the type of person if I don't enjoy something I won't give it my all because I'll easily lose interest'.* *'One of the things that actually seems fun'.* *'Imagine myself like going to the work every day with a smile on my face'* and would not *'have to think about a time'.* *'Higher morale, a higher self-worth and a better value of life compared to many others'.* *'They are in a low stress industry with higher rewards good pay and high levels of self-actualisation'.* *'Engineers are satisfied with their performance and their work-life balance'.*		

fathers) and siblings. It is interesting to note that this theme was mentioned by 47% of female students (7 of 15) and only 33% of males (22 of 62).

- 'Problem solving' was spoken of in very general terms and there was little discussion of what constituted an engineering problem apart from in the context of technological development and climate change. The theme was linked with the self-efficacy developed during learning experiences. For example, one student said they 'enjoyed it … being able to solve a problem so impossible to me' and that it 'was exciting and after considering a load of possibilities I've found a solution'.
- The 'perseverance' needed to study and practice engineering was sometimes linked to students overcoming barriers such as 'not doing so well on my A-Levels' which is perhaps unsurprising

given the nature of the students who took part in this study. This finding is of interest given the increasing emphasis placed on the need for graduates to develop 'resilience' (UCAS 2018; UNITE 2017) and highlights an area of potential future research.

- Students referred to having previous learning experiences which involved 'teamwork', which appeared to act as sources of self-efficacy. Students also commented on their personality, for example one participant considered themselves to be 'a pretty social person' who became close with people they worked with which led to them 'really enjoying work'. It was notable that all of the students who mentioned teamwork were male. This finding may be associated with the fact that women are a minority within a discipline such as engineering.
- Only one female participant mentioned salary as a factor that influenced their career decision, this being consistent with the work of Dick and Rallis (1991), who, found pay to be a more important factor for men when considering career choice. Some students quoted average salary values suggesting that their decision had been informed by researching career options or family and friends. Students quoted values of money that they would like to earn when they started their career, these ranging dramatically from £25,000 to above £50,000. This finding hints at the role that background, and contextual influences may play in forming aspirations. Some students believed salary to be an important consideration as they wanted to provide 'a comfortable lifestyle … something I want to be able to do for my children'. Another commented that the salary was important 'for people who plan on raising a family' which they considered was 'definitely a factor' in their choice of degree. These comments were made after students had explained the way in which their father had provided for them and their family.
- Only one female participant spoke of a desire to travel. Travel was often linked with personal interests, one student saying 'traveling is a hobby of mine'. Some students had 'already checked for example how to emigrate to Australia … Canada and like it said like if you have like an engineering degree' and another saying they would 'have to become a chartered engineer', these quotes demonstrating the way in which career aims and choices are informed. It was interesting to note that the majority of those who spoke about travelling were civil engineers, something which may be associated with the number of references made to the infrastructure and buildings that students admired whilst travelling.

3.7. Proximal environmental influences

Proximal environmental influences were most commonly mentioned by those students who had not alluded to either family members or learning experiences in their decision-making process. One participant described stumbling across engineering on an open day for another subject and subsequently cancelling all other open days. One female student described how she had 'not even crossed paths of engineering' before her science teacher nominated her to be part of an engineering challenge led by a local university. She described this as 'the most exciting day' adding that 'from that moment on I knew it was what I wanted to do' and applied to study engineering. A different participant said that they finally decided 'to become an engineer' after 'a speaker came in for assembly in A level Sixth Form'. One student who had been in the army applied to study engineering upon finding 'out about the army paying for a degree'. For this student it was therefore the financial support that appeared to contribute to their active decision-making process.

Other students described barriers they encountered during choice making, for example one student referred to 'some setbacks such as not doing so well on my A-levels'. This meant that they had to consider a different route to studying engineering.

Although these findings remind us of the need to further ensure that both parents and teachers have a good understanding of the nature of the engineering profession, they also demonstrate the power of 'fortuitous' events that encourage students to study engineering. The use of proximal influences on the decision to study engineering may be of particular interest considering the suggestion that men are more likely to 'drift' into engineering (Powell, Dainty, and Bagilhole 2012).

3.8. Choice action

Within this work, applying to studying engineering is referred to as the choice action. 63% of students alluded to the specific discipline that they were planning to study upon completing the FY (for this particular scheme a choice of discipline can (or not) be stipulated at the start of FY but can be changed up to the point of enrolment for Year 1.

Students provided insight into the various learning experiences that had influenced their choice. Those planning to study Medical Engineering tended to focus on their experiences with the medical profession, for example, one student had become interested in studying Medical Engineering after having 'a rugby injury which led to me have the operation on my collarbone', saying that they 'became basically fascinated by just the engineering side of medicine', with others speaking about family members who had had undergone various health procedures. Aerospace students predominately alluded to everyday situations in which they had been exposed to aircraft, with some attending air shows and others travelling from airports. Others were interested in space and the exploration of 'unexplored territory in the solar system' and the 'growth of a multi-million-pound industry including big companies such as NASA, Rolls-Royce SpaceX, Airbus' which 'would be a dream to work for' as they had 'exciting projects and with massive futures'. Civil Engineering students tended to be more focused on design and infrastructure. Many spoke about significant structures and historical monuments. Both the examples given by aerospace and civil engineering students highlights the role that exposure to our surroundings play in informing our career decisions, and perhaps explains why these disciplines are two of the post popular amongst students.

Some students alluded to future choices, describing the FY as an opportunity to decide which discipline to study, with one saying they would see 'if mechanical was for me' and what their 'options were' as they had 'never felt as if I was really passionate about it'. The same student later mentioned an interest in aerospace engineering, saying 'I'd heard of aerospace a lot, but we hadn't really done it that much in our college course' this highlighting the role of prior learning experiences on outcome expectancies and informing choice. A different student had similar feelings saying that they wanted to use the 'time in foundation year … to make sure that becoming a mechanical engineering really is for me … there are so many forms of engineering … It depends on which topics I prefer the most I guess'. Another considered that the FY provided 'the perfect opportunity to explore the engineering courses and choose the right one for me'. The final finding is important for educators who are unaware of students' expectations regarding help with their decision-making process during their FY studies.

4. Discussion of findings

The findings clearly demonstrate the complexity of the career decision process and the way in which person inputs and contextual factors influence learning experiences, self-efficacy, and outcome expectancies. This section will focus on two of the more interesting findings related to (1) the preconceptions that students may have about engineering practice and the 'ideal' engineer and (2) the role of sustainability, the environment, and social justice in encouraging students to study engineering. These findings were chosen for more in-depth discussion for several reasons. The first of these sections (entitled the 'ideal' engineer) covers a wider range of subthemes, primarily those related to background contextual influences, learning experiences, and outcome expectancies. Taken together these themes help to create a picture of the way in which various factors can contribute towards decision-making. It was deemed important to discuss this in more detail due to way in which idealisation may affect both the retention and progression of students. Perhaps as important, is the information that can be gained about the way in which students, who wouldn't otherwise consider engineering, are influenced by societal perceptions of engineering. The findings covered in the second section (entitled creating sustainable and just societies for future generations) were chosen for discussion due to the increasing emphasis on the requirement for engineers to contribute toward the complex socio-technological challenges within our society. This need has been highlighted by the UK government (Perkins 2013), professional institutions (NAE 2004; Royal Academy of Engineering 2007, 2014), as well as industrial stakeholders (CBI 2009; McMasters 2004) and is considered 'vital for the development of future orientated, sustainable and socially responsible engineers' (Royal Academy of Engineering 2018). Given the potential to attract underrepresented groups of students to engineering (Godwin et al. 2016; Orr et al. 2009), it is of interest to understand, in more detail, how many students (when not specifically asked) mention sustainability and social justice issues as reasons they want to study engineering, as well as the factors that led to this being their motivation.

4.1. The ideal engineer

It was clear that many of the students who took part in this research were heavily influenced by their surroundings, including the media, famous figures, and technology. The majority of students highlighted the importance and status of engineering to the society and the role that it played in improving quality of life and both societal and technological advancement. There seemed a common desire to work for 'big companies like NASA, Rolls-Royce SpaceX, Airbus', with 5 (male) students mentioning that Formula 1 racing was part of what inspired them to study engineering. One of the five aspired to 'becoming someone important in F1' saying that that was 'probably my dream dream job'. This finding demonstrates the way in which learning experiences influence outcome expectancies including 'becoming someone important'.

Related to the respect for large businesses was that for 'self-made' engineers, particularly those involved in space travel. One participant spoke of one famous figure who 'has an incredible back story from just teaching himself basic coding at age 9 to now having a net worth $21.8 billion' and another saying that they were 'inspired because he dropped out of Stanford just after 2 days to create his own company'. They considered that this 'proved … anything can happen if you put your mind to it'.

Neoliberal ideas are perhaps appealing to FY students, many of whom have faced adversity or followed untraditional routes into education. However, Berge, Silfver, and Danielsson (2019) highlight the risk associated with neoliberal notions about the self-made engineer, which they believe 'could derail an awareness of how society is structured by gender, social class, and ethnicity' (650) and their ability to reflect upon the ways in which engineering practice can work in combatting social injustice.

Despite ambitions to work for specific companies, participants only made vague reference to the work that engineers do. For example, many spoke of problem solving without giving any reference to what constituted and engineering problem. Others spoke of enjoying mathematics and the sciences without any suggestion of how it was applied within engineering. Perhaps, most noticeably, students appeared to have an idealised image of working as an engineer, something which was made clear by the way in which they spoke about the diversity of the role, claiming that they would not be 'stuck in an office all day and doing monotonous tasks … look forward to doing something new every day' and stating the belief that if they 'were to not like a part of it' they would be able to move on to something else. It is interesting to note that only 20% of female students mentioned job variability as a reason for studying engineering compared to 30% of men. Many students also alluded to happy engineers, saying they had 'higher morale, a higher self-worth and a better value of life compared to many others' or that 'they are in a low stress industry with higher rewards good pay and high levels of self-actualisation' and 'are satisfied with their performance and their work-life balance'. However, they did not provide any detail about how they knew this.

Although it is likely that family and friends, as well as national marketing campaigns played a role in students' perceptions of engineering, the frequent references made to famous figures, films, games, television, and news highlight the significance of the media during decision making, but also serve as a warning about the ways in which students may idealise engineering careers. Tseng, Chen, and Sheppard (2011) previously suggested that there was a need to ensure that students receive accurate information prior to starting a course and warned that a misalignment of expectations was likely to lead to disappointment and in reduced retention of students. This is something which is of particular interest for those who teach on FY and first year engineering programmes, particularly when considering the, sometimes, mundane nature of introductory engineering study. Those who teach FY students may therefore consider the ways in which engineering practice is conveyed within their programmes, which typically consist of discrete science and mathematics-based modules.

4.2. Creating sustainable and just societies for future generations

Many students spoke of a desire to make the world a better place to live, many linking this to sustainability issues and the need to care for future generations. However, students had varying perceptions of what would make 'the world a better place to live', or 'improve quality of life', with the majority speaking about technological advancements including faster computers and smaller phones, with one student claiming that 'laptops, phones and robotics … increased quality of life for the *whole* of humanity'. Participants seemed naïve to some of the ways that engineering contributed toward climate change, for example, the need for engineers to work towards sustainability was often juxtaposed with them being at the 'forefront of technology with the introduction of … smaller and smarter phones, self-driving cars' and their role in the world becoming 'more and more advanced'. Such perceptions are likely to be associated with the ways in students consider engineering to influence their own lives, and thus their learning experiences.

One notable exception was the discussion of social justice issues, primarily by those who had either lived abroad or done a lot of travelling, this demonstrating the way in which background contextual influences and learning experiences can affect decision making. These students spoke in terms of their 'position of privilege' and of a desire to help those 'who do not get to benefit' from many of the engineering solutions available within the western world. Students clearly recognised the injustice that could be associated with the engineering profession with one saying that 'the richest countries use significantly more of natural resources than the poorest'. These findings again demonstrate the ways in which choice actions can be influence by background contextual influences as well as learning experiences. They also indicate that efforts which focus on providing students with an understanding of social injustice within their own communities could help increase recruitment of UK students.

It is also interesting to note that female students were more likely to mention helping people/the society (60%) or social justice issues (40%) compared to male students, 37% of which alluded to helping people, and 10% to social justice issues.

These findings highlight opportunities to attract a wider range of students to engineer. For example, female students' career choices have been shown to be influenced by an interest in human-centered professions on numerous occasions (Gill et al. 2008a; Woolnough 1994), Many authors claimed this to be a reason that women are less likely to study STEM-based subjects such as engineering (Eccles 1994; Faulkner 2007; Hewlett et al. 2008; Woodcock et al. 2012). More recently, the idea of contributing towards sustainability issues has been shown to act as a factor which is likely to encourage women and other minority groups to study engineering (Godwin et al. 2016; Orr et al. 2009).

However, the findings also reveal a lack of awareness as to who engineering benefits, and of any of the negative impacts of engineering to society as a whole. Such findings are consistent with those of Klotz et al. (2014) who show that although engineering attracts students who wish to contribute towards issues such as climate change and energy supply, it is less likely to be pursued by those interested in equity and poverty. The authors suggest that these trends will result in solutions of limited effectiveness in combatting sustainability issues. There is therefore a clear need for further work which focuses on the education of both current engineering students, and those who may be attracted to study engineering.

5. Limitations

This study made use of a convenience sample of 82 students studying on one engineering FY course in a UK HEI. The transferability of findings, which may be influenced by factors such as the type of institution or the intake year, is therefore limited. Observer effect was believed to be limited by the fact that students were asked for permission for their submissions to be used as research data prior to receiving their grades and by the fact that students were not assessed on the content of their submission (see marking criteria in section 2). Whilst none of the marking criteria explicitly focus on the answer the students give to the question (only that it is relevant to the title *Why I am studying engineering*), the author recognises that students would be aware that their module coordinator would watch the video which may result in them focusing on socially acceptable reasons for wanting to study engineering. Whilst it is difficult to determine the extent to which consideration for social acceptability played a role in the content of the submissions, the majority of submissions included personal details which, in most cases were explicitly linked with motivations discussed. For example, in the case that students stated reasons which some may consider as socially acceptable (for example a desire to help people or environmental concerns), they did so in the context of the events which had led to that motivation (for example the needs of people where they had grown up). Conversely some students also mentioned reasons associated with self-gain (e.g. status and legacy), which some may not consider as socially acceptable. It should also be noted that reasons considered to be socially acceptable vary between individuals. Thus, even a submission from a student who was intent on ensuring that their reasons were socially acceptable, would provide insight into the reasons that people think should influence them when choosing a subject to study.

Future work may benefit from a quantitative approach that includes a wider range of students from different institutions, and geographical locations. It is also recognised that this data is only able to provide a snapshot of students' motivations, and without collecting longitudinal data it is not possible to understand the way in which motivation shifts over time.

Nevertheless, this study highlights multiple areas in which there exist considerations and opportunities for those interested the recruitment and retention of underrepresented students in engineering.

6. Conclusions

Digital storytelling has been used to understand the reasons that students have for studying on an engineering Foundation Year (FY) programme. The work demonstrates both the suitability of digital story telling as a method which has the potential to obtain authentic data, and the complexity of the career decision process and the way in which person inputs and contextual factors influence learning experiences, self-efficacy, and outcome expectancies.

The findings demonstrate the role that family members play in career choices. It was noticeable that those students who did not mention the role played by family or friends, tend to describe their exposure to engineering as fortuitous. It was clear that women feel a certain sense of duty to study engineering and were more likely to mention the membership of clubs, work experience or attending summer schools as influencing their choices. Some participants expected to find out more about engineering careers during their FY, something which may be of concern to educators who teach on FY that typically focus on the fundamentals of mathematics and sciences. Many students seem to have an idealised conception of engineering, something which appeared to be heavily influenced by the media, famous personalities, and technological advancements, and which poses a risk to retention and progression of disillusioned students. It was also noticeable that students had a limited awareness of the negative impacts that engineering can have, and about social aspects of sustainability, something which may risk the effectiveness of future engineering solutions.

Whilst there is little evidence to suggest that the motivations of students studying in the FY vary significantly from those who are directly enrolled within the first year, the use of SCCT allows for insight into the way in which various inputs, influences, experiences, and expectancies influence the decisions of a variety of students who have entered HE via an untraditional route. This information allows us to understand the reasons that they have been unable to enter year one, whether it be academic, the result of limited exposure to engineering, or otherwise. This is helpful in both design of outreach and recruitment efforts which could both focus on attracting students to study on the FY or raise awareness to students earlier in order to ensure they are eligible to enrol in the first year. The findings are thus of relevance to those interested in both the attraction and retention of engineering students, as well as widening participation within HE.

An exploratory approach was used in this work to allow students to reflect on their reasons for studying engineering honestly. The lack of prescription in the topics covered is beneficial as it allows students the freedom to express themselves, and is more likely to result in them focusing on the things which are most significant to them. However, this type of study has several disadvantages. For example, it would have been useful to specifically ask students why they had enrolled on the FY as opposed to entering Year 1, and future work may therefore include a comparative study into differences between the reasons cited by students starting engineering degrees in FY and Year 1. It would also be interesting to probe students further about some of the themes mentioned. For example, questions could focus on: student understanding of how mathematics and sciences are applied within engineering; what constitutes an engineering problem; how students know that engineers had low stress levels and high self-efficacy and self-actualisation.

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