Me as an engineer: Career aspirations and expectations of South African first-generation engineering students

Felicity Harris [1] Bruce Kloot [2] Renee Smit[3]
[1]*Department of Mechanical Engineering, Cape Peninsula University of Technology, South Africa.* [2]*Department of Mechanical Engineering, University of Cape Town, South Africa.* [3]*Department of Electrical Engineering, University of Cape Town, South Africa*
[1] harrisf@cput.ac.za; [2] bruce.kloot@uct.ac.za; [3] renee.smit@uct.ac.za

This paper reports on the findings from a larger project that focuses on the career expectations of a group of first-generation students at a university of technology in South Africa. For many first-generation students, walking the pathway to realising the dream of becoming an engineer involves two new experiences, higher education and the engineering profession. For both these environments, there is no inter-generational experience to tap into. A deeper understanding of engineering, and exposure to the engineering industry, only happens during their studies. The theory of possible selves was used as a theoretical framework for this investigation, drawing on the notion of elaboration, which is the extent to which an individual knows enough about the possible self and the pathway needed to achieve that possible self. Through semi-structured interviews, participants told the story of their journey into studying engineering in higher education and shared the experiences that formed their future selves. The data collected answered the research question: What factors influence the shift from career aspirations to expectations in the elaboration of the possible self for first-generation students? The data revealed that most students had the aspiration to become an engineer before they completed their high school. This aspiration was, however, moulded by limited information on what engineering is, the qualifications required to enter the workforce at the professional level they desire, and the period of time it would take them to realise the vision they have for themselves as a practising engineer.

Introduction

The widening of tertiary access in South Africa after the 1994 democratic elections meant that many students who entered university were the first in their family to do so. Although it is now nearly three decades since South Africa emerged from apartheid, there are still a good number of students who enter engineering at tertiary level as first-generation students. For many of these students, exposure to engineering – in terms of the engineering curriculum, the demands of study and the place of engineering in broader society – only happens during their higher education studies. As with all engineering students (Reed & Case, 2003), first-generation students choose engineering because of their *aspirations*, including 'saving the world' or 'making lots of money'. While engineering certainly has the potential to open up opportunities, it can also serve to 'chisel down' aspirations to more realistic *expectations* of what is possible to achieve given their knowledge, skills and experience (Holland, 1997).

This paper emanates from a doctoral study that deals with the role of peer mentoring in the development of students' engineering identity as they transition from high school. It focuses on first-generation students at a university of technology in South Africa and uses the theory of possible selves (Markus and Nurius, 1986) to understand the process of identity development. The larger study focuses on the difficulties that first-generation students experience as they transition into higher education and examines whether

students' engineering identity is commensurate or in conflict with other facets of their identity, such as their social identity or their home identity. The reason for focusing on first-generation students is because of the challenges they face in adapting to the higher education environment, one that is likely to be unfamiliar to them. It is hoped that the findings from this study will create opportunities to support first-generation students in making well-informed career choices and negotiating engineering education if they choose this as their field of study.

This paper does not address the topic of mentoring (which is an important aspect of the larger study) but focuses on career aspirations and expectations, concepts that align with the theory of possible selves. It examines the sources of inspiration, knowledge and understanding of first-generation engineering students when they enter university, and how these develop into career expectations as the student journeys through higher education and gains a greater understanding of the engineering profession. Our interest is in which factors – or sets of factors – influence first-generation students as their inspirations shifts to career expectations during their time in higher education. The research question addressed in this paper is thus:

What factors influence the shift from career aspirations to expectations in the elaboration of the possible self for first-generation students?

The following section deals with the literature around first-generation students and moves to an explication of the concepts that are mobilised for this study's theoretical framework. Thereafter, the methodology drawn on for this paper is outlined, the findings are presented and discussed, and some preliminary conclusions are drawn.

Literature review

The literature about first-generation students has expanded in recent years. The terms *first-in-family* or *first-generation* students are often used interchangeably in the literature, but essentially mean that neither parent engaged in higher education studies (Dumais et al, 2010, O'Shea et.al., 2017, Delahunty et. al., 2021). For the purposes of this paper, the term *first-generation* is used.

Verdín et al. (2018) studied the factors that influence first-generation students in identifying as engineers. They distinguished three facets of engineering identity development that gave students a sense of belonging and affiliation to engineering. These facets were: an interest in engineering; recognition by others (especially those from the student's social context); and tangible measurements of performance or competence. The sense of belonging identified by Verdín et al. (2018) was found to have a direct impact on the motivation of these engineering students to complete their studies and their vision a successful career in engineering in the future. Godwin (2016) and Godwin et.al. (2020) had similar findings.

Martin et al. (2020) found that support offered before entering university, as well as support offered by the university community in combination with the student's social context while studying, sets the basis for persistence in studies. This study focused on first-year students at a university in the United States, and it was found that first-generation students and 'continuing generation students' (Martin et al., 2020, p. 1) shared common social offerings in terms of support. These offerings of support came from parents, other family members, school, peers, and personnel on the STEM programmes that were part of the study. A significant factor in terms of the support offered was its timing. The study found that before entering university, parents of first-generation students were only able to offer emotional support, and that decisions about career and

future pathways related to the career, were made by the first-generation student while enrolled at university. In the case of 'continuing generation students', parents provided engineering specific advice before entering university and offered emotional support to students while they were enrolled at university.

The theory of possible selves

The theory of possible selves was developed by Hazel Markus and Paula Nurius in 1986 as a complementary idea to studies on self-knowledge. Markus and Nurius (1986) describe possible selves as an individual's ideas of 'what they might become, what they would like to become and what they are afraid of becoming' (p. 954). They emphasise that it is not about what one sees oneself as now, but rather how one sees oneself – or does not want to see oneself – in the future.

The theory of possible selves is described as a conscious thinking about one's life in the present day by looking at what one would like to see oneself as in the future (positive possible self), or what one would not want to see oneself as (negative possible self). Aspirations for a positive possible self, act as motivators to achieve the positive possible self. These motivators are drawn from an individual's socio-economic environment, known as the 'pool of possible selves' (Markus and Nurius, 1986) and are postulated to having a direct influence on the career choices individuals make (Harrison, 2018).

An important idea that is part of the theory of possible selves is that of *context*. According to Markus and Nurius (1986), one's current context and what one has experienced in the past greatly influences what one sees oneself as in the future. Individuals will compare themselves to those within their socio-cultural context and use their context as a marker of what they aim to achieve or do not want to achieve. It is within this socio-cultural context, through interactions with others, that an individual's values are shaped in terms of which possible selves are considered to be attractive, appropriate or achievable.

Markus and Nurius (1986) theorise that, depending on where and how motivations are sourced, the various possible selves may not be 'anchored in social reality' (p. 955) or actual social experience. A notion that is relevant here, and which links to the concepts of aspirations and expectations is that of 'elaboration'. Elaboration is described as the extent to which an individual knows enough about the possible self and the pathway needed to achieve that possible self. It is also a demonstration of a strategy to achieve the possible self (Markus and Nurius, 1986). Oyserman (2011) in her detailed study of the pathways to achieving possible selves, found that high school learners see success at high school as an important destination, but that the pathway beyond that destination is not always clear. Students may not have been fully informed and prepared while at high school about the requirements (e.g., entrance to higher education) for meeting their career goals.

Oyserman and Markus (1990) therefore argue that a resource-rich student context (family, community and/or school) will provide 'automatically cued' strategies from parents, teachers and the broader community, whereas a resource-limited context will not have these strategies easily accessible to the individual. Oyserman and Markus (1990) use the example of low-socio-economic status context, but the same could be said about the socio-cultural contexts of first-generation students, where the context for the student is resource-limited due to the fact that no-one in the immediate family has engaged in studies at higher education level.

Career aspirations and career expectations

The terms *aspirations* and *expectations* were mentioned at the start of this paper and are a key part of this study. In the literature, *aspirations* are defined as the hopes an individual has of achieving something. As a sub-set of the many aspirations an individual has, career

aspirations are described by several authors as 'vocational possibilities and work preferences' (Metz et al., 2009), 'point-in-time expressions of career-related goals' (Johnson, 1995) and 'abstract statements' (Khattab, 2015) about career desires. A career aspiration is basically seen as a response to the statement: *The job I would like to have is.*…

Khattab (2015) suggests that aspirations are in all likelihood 'disengaged from socio-economic realities' which leads to what he and other authors describe as the 'aspiration-achievement paradox' (Hill and Torres 2010, Becker et al., 2022); namely, that students from ethnic minorities or with immigrant backgrounds often have higher educational aspirations than their 'mainstream' counterparts despite having below-average school performance. The studies referred to above were conducted in Europe, the UK and the United States so the term 'ethnic minority' or 'immigrant' have particular meanings in these contexts. It should be noted that in this study, the vast majority of first-generation students, are black[1] students who make up the *majority* population group.

Expectations are defined as what an individual believes will happen when evaluating the realities of a particular situation. Khattab (2015) describes expectations as 'assessment[s] of the likelihood of the event, behaviour or outcome' (p. 734). This assessment involves examining, for example, the factors of one's socio-economic circumstances and how they might influence one's aspirations. Career expectations are described by several authors as 'realistic and accessible career choices' (Metz et al., 2009) or 'an assessment of the likelihood that an event, behaviour or an outcome will occur' (Khattab, 2015) and is basically seen as a response to the statement: *The job I expect to have is.*…

While aspirations are mostly likely disengaged from socio-economic realities, as described above, most studies indicate that social context *does* influence career expectations and that ethnic minority groups or students from immigrant backgrounds expect less career opportunities and experience barriers reaching their career goals (Barg et al., 2020, Metz et al., 2009).

Methodology

Given that this paper aims to provide insight into students' understanding of their possible selves, a qualitative approach within the interpretivist paradigms was chosen. The semi-structured interview was selected as the preferred data collection method, since it allows interviewees to freely reflect on their past, where they find themselves at present, and the effect of these on their visions for the future. Table 1 (see Appendix) shows some of the broad and generalised areas of discussion within the semi-structured interview. Narrative inquiry (Polkinghorne, 1995) was used to analyse the data as it enables the drawing together of 'diverse events, happenings and actions of human lives into thematically unified, goal-directed processes' (p. 5).

A particular university of technology was chosen as the case study location. It is worth noting that the programme at such a university trains students to become *engineering technologists* according to the categorisation of the Engineering Council of South Africa (ECSA). However, the general term 'engineer' is used to describe the professional pathway of the students. Within this institution, the Department of Mechanical

[1] The term 'black' in this paper refers to those categorised as 'non-white' under the apartheid government. This includes those classified as black African, 'coloured' and Indian. It is acknowledged here that 'race' was used as a construct to institutionalise oppression in South Africa and such references are not intended to entrench racial classifications. However, given the history of South Africa and the nature of this study, it is impossible to avoid the use of this designators.

Engineering was selected. The reason for this was the relative ease of access this afforded the researcher. The mentoring programme within this department was used to invite students to participate in this study. These respondents were drawn from two groups:

- First-year students who were *mentees* (students being mentored). All of these students were asked to complete a short survey to identify the first-generation students. Of these, 10 students responded to an invitation to participate in the study and were interviewed at strategic points as they transitioned into university: twice during their first year of study and then at the start of the following year (three times in total). The purpose was to gauge if there had been any changes in their perspective as they progressed through their engineering qualification.
- Senior students who were *mentors*. These students were also asked to complete a short survey to identify whether they were first-generation students. Again, this yielded 10 respondents. Most of these students were in the third year of their diploma course and some were doing their advanced diploma and were thus in their fourth year). Students in this group were on the brink of doing their Work-Integrated Learning (WIL) or had just returned from WIL and were preparing to go into industry.

Ethics clearance was obtained from the university ethics committee, being granted on the grounds that pseudonyms would be used to protect the respondents' identities. At the start of each interview, the researcher explained about the protection of personal information and issues of anonymity, and checked with each interviewee if they were still willing to continue. The respondents signed a consent form before participating in the interview.

Findings

These findings explore the knowledge, understanding and sources of inspiration to study engineering and how these developed into career expectations during the higher education journey.

Sources of inspiration

In reflecting on the origin of their inspiration to study engineering, students mentioned the pivotal role that community and school played in their decision to pursue a qualification in engineering at university. It is through interacting with and observing members of the community or family that the spark was ignited. Mandla and Xolani were both inspired by members of their community. For Mandla, his friend's father was an engineer and became a role model for him. In fact, he said that he continues to be motivated by this man, even while he is studying. Xolani drew his inspiration from his uncle who worked in the engineering sector. Even though this uncle died when Xolani was very young, he describes how finding remnants of his uncle's work intrigued him and motivated him to find out more. This led him to making the decision that he wanted to study engineering even before he matriculated.

> I had a friend, his father was an engineer, so I used to ask him about engineering stuff and then I got interested about his career and then since then, I told myself that I want to be like him. When I think of him, I always get motivated so that I can become more better than what he has done (Mandla, first-year student).
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> I found drawings, like plans of houses and all that, so I wanted to do that too. So, when I researched more, I saw it was engineering (Xolani, first-year student).

Eric, on the other hand, did not know what he wanted to do after high school but came to the decision to study engineering because of his friends. While his parents did not

influence him regarding a particular career, Eric affirms that they were supportive of his decision to study engineering.

> I remember in high school, I was a bit undecided. I didn't know what I wanted to do. So, I asked my friend, 'What are you studying' and he said, 'I'm doing engineering.' Then I asked the other one what are you studying, he said, 'I'm doing engineering.' So I was like, 'Okay, cool. I'll do engineering too' (Eric, first-year student).

> So, with my parents who didn't go to university, they don't push as much… to go into this particular field. They just know that getting a university degree is important. So, as long as I have one in a respectable field, then it's okay (Eric, first-year student).

Lutho explained that he was not inspired by a particular community member but that this happened through a career exhibition at school:

> We went to a career exhibition… and were seeing a lot of things in different careers, geologist, engineers and all those things and we even went to a mine (Lutho, senior student).

The inspiration to embark on a career in engineering evolved into a plan of action for these first-generation students. They relayed how they obtained information about engineering and, in some cases, even learned that the 'job' they had a particular interest in was called engineering. The data showed that it was either through a teacher at school or by researching on the internet that they found the answers they were looking for.

> I was close to my physical science teacher, so I asked him, 'Is it safe that I'm doing physical science for being an engineer?' (Lutho, senior student).

These findings about career aspirations speak to the influence of one's social context in terms of presenting possibilities for careers (Markus and Nurius, 1986) as well as the support offered by social context (Martin et.al., 2020; Verdín et.al., 2018; Godwin, 2016). Some of the interviewees mentioned the supportive role their school played in assisting them with their university applications, particularly when they experienced setbacks in this process:

> They will assist you to apply, to use the computer lab and I think even in matric there was a session that has been allocated for us to apply at universities where there was a teacher assigned to assist us to apply online (Jane, senior student).

As stated in the literature, although the aspiration may be present, the pathway to realising this aspiration is not necessarily very clear (Oyserman, 2011). Several interviewees felt that the school offered little to no help in terms of their pursuit to study at university, and particularly to pursue studies in the STEM field. One interviewee recalled when she had to choose her subject stream for the last three years of school and her decision to follow the science stream (physical science and mathematics). She did not make the choice based on information she had about careers in the STEM field, but pushed to do the subjects because so few students were choosing to do these subjects:I didn't know what subjects to choose. I firstly went to the accounting class. I also don't know why I chose the accounting class… all of the students were going to the accounting class, they were running away from physics and maths, they were saying that physics and maths is very difficult. The teachers were checking how much we got for maths and natural science and that's how I got into studying maths and physics (Lerato, senior student)

Despite limited resources and lack of sufficient information in many cases, the interviewees displayed great enthusiasm for engineering when the spark was ignited. What was of utmost importance, was how this aspiration was translated into action when they embarked on the journey to study engineering.

Student expectations

The three interviews undertaken with first-year students provided some insight into their thoughts about what engineers do and allowed them to reflect on whether their understanding of engineering was different to their initial ideas or thoughts about what engineers do. Mandla assumed at the start of his studies that he was going to be working on cars, but mid-way through the academic year realised that engineering was not 'just about fixing cars'. By the end of his first year of study he had come to the realisation that engineering was actually about 'designing and creating'.

> **Interview 1**: About mechanical, it's about fixing of cars and maybe electronic stuff, of fixing electronic stuff, yes.
>
> **Interview 2**: I thought maybe if you are doing mechanical maybe you are going to be a mechanic. So, since I'm here in varsity I can see that if you are doing mechanical engineering, you can do maybe a lot of things.
>
> **Interview 3**: I can say that being a mechanical engineer you can be a designer and create many things.

The clarity about engineering that Mandla experienced as he engaged with higher education echoes the benefits that Martin et al. (2020) report in their exploration of the interactions between first-generation students and engineering professionals. In both cases, students' were encouraged to continue in their pursuit of engineering as a career choice.

Eric, who chose engineering because of what his friends were studying, battled at the start of his studies to 'make connections between what is taught in the class and the working world' (Interview 1). At the end of his first year, he came to the conclusion that engineering is about finding solutions for society.

> **Interview 3**: It's a very broad sector but essentially, it's just the manipulating and using rigid mechanical parts to create something that produces an output… so you can work on cars, you can work on oil rigs, you can work on fridges, microwaves – just creating.

In his second interview, Xolani shared his realisation that engineering was not just about 'working with the hands'. In his third interview, he reflected on the rather narrow understanding about engineering that he held:

> **Interview 3**: When I was in high school, I never had broad enough information about engineering; now I'm actually more interested than before…

Acquiring additional information or obtaining a clearer understanding of one's aspirations during higher education can lead to a shift in career expectations. This could leave the individual feeling inspired, demotivated or inclined to change her/his initial plans. This was explored through the final question in all interviews which inquired from the respondent where they might see themselves five years from the day of the interview. This provided a good way of comparing how pathways changed or become more or less clearly elaborated.

Sipho, a first-year student, had the following to say at the end of his three interviews:

> **Interview 1**: When I finish my diploma I want to study further, so I would do my advanced diploma then and even go further, yes, studying, studying, studying.

In the second interview he had doubts about whether he wanted to study beyond his national diploma:

> **Interview 2**: I always thought that let's say once I've done with my diploma maybe I will be more confident about studying further.

In the third interview, Sipho seemed to have regained some of his confidence in his studies:

> **Interview 3**: I wish to further my studies – maybe do an advanced diploma. And if I feel that I still love school, I'm going to go ahead and do my Master's. Industry? It might happen at the same time, that's what I'm thinking.

When the same question was posed to the senior students, their responses were a bit more detailed about where they saw themselves. This was because they had either completed their six months of WIL and were enrolled for their advanced diploma, or they were about to embark on their WIL and had to give some serious though to their imminent future. Jane was a senior student who had taken longer than planned for her studies. She felt that life had thrown her many 'curve balls' but she had nevertheless persevered. She had managed to finish her WIL and needed to make a decision about the future.

> My desire is still to do something in aeronautics or work on aeroplanes, maybe design a part of it, if possible, if I can have my own company design a part for a plane… that is my desire but life really throws you a different route (Jane, senior student).

But after some thought she added:

> I have always had a desire to go in the business industry of engineering, so maybe corporate but in an engineering firm. So, I am hoping to continue my studies, I am hoping to have some stable job, permanent income. Yeah, I think I just want some stability and clear direction (Jane, senior student).

Similarly, the realities of the working world and a considered view of what is 'out there' was clearly reflected in the response of Lerato, also a senior student. She had completed her national diploma and decided to enrol for her advanced diploma:

> I did not get permanent employment when I was doing my WIL. I did not want to stay at home and do nothing. Secondly, I saw that advanced diploma will be in need in coming years. I know as time goes on, they will require an advanced diploma and not just a diploma (Lerato, senior student).

Discussion

An overall analysis of the findings led to the development of four distinct phases on the aspiration-expectation spectrum that first-generation students go through as they progress toward attaining their vision of their possible self. This framing proved to be useful in terms of understanding the findings.

Phase 1 can be seen as the time in which the spark is ignited which develops into an aspiration. It is also the phase in which investigation into a possible career begins but the pathway to realising the aspiration remains unclear. At this point the individual finds out as much as they can from from the resources available to him or her.

Phase 2 is where the aspiration to be an engineer becomes even more prominent since it is fuelled by the accomplishment of making it into university. This accomplishment is a huge motivator and encourages the student to 'dream big'. The decision to be an engineer is still strongly influenced by the student's socio-cultural context. This phase is experienced by first-year students at the start of their studies.

The student enters Phase 3 as the first year of study draws to a close. In this phase, the university context and experiences such as assessment results, practical exposure to engineering, and engagement with other students, are added to the evaluation of the choice to be an engineer. The visions of the future as an engineer are still heavily influenced by the aspiration, but some features of the reality of being an engineer such as qualifications, experience, and specialization, are factors that are considered. In this phase there is a marked shift along the spectrum towards expectations.

Phase 4 is marked by perceived barriers of, for example, financial constraints, lack of confidence, family influences, and in some cases a lack of self-efficacy in making decisions about an engineering career. This phase was especially evident in the interviews with the senior first-generation students. Compared to the other phases, there was a clearer shift as the initial aspiration (from phase 1) was chiselled down to a more realistic expectation of 'being an engineer' out in the working world.

This suggests that elaboration of 'me as an engineer' become more clearly defined through each phase, as personal factors (family opinions, community ties), objective factors (career specialization, labour market trends) and subjective factors (generational influence, self-concept) influence the the shift from career aspirations to expectations in the elaboration of the individual's possible self.

Conclusion

This paper, which emanates from a larger study that draws on the theory of possible selves, focused on aspirations and expectations of first-generation engineering students at a university of technology in South Africa. It explored the sources of inspiration, knowledge and understanding of engineering students when they enter university, and how these develop into career expectations as the student journeys through higher education and gains a greater understanding of the engineering profession. The literature suggests that aspirations are likely to be 'disengaged from socio-economic realities' (Khattab, 2015) and this certainly seems to be the case in this study. In terms of expectations, the broader social context seemed to temper career expectations of the first-generations students in this study, but these barriers did not appear to be insurmountable.

On the spectrum of aspirations to expectations, this study suggests that the vision of the pathway ahead for first-generation students is not very clear due to limited information about engineering and higher education, and limited networks to facilitate gaining exposure to the engineering industry. The pathway becomes clearer as the student engages higher education, gains a deeper understanding and reassess their aspirations. While the literature limits students' reassessment to socio-economic circumstances, the findings of this paper indicate an array of factors that influence the process of elaboration. Furthermore, the reassessment of the pathway appears to moderate the aspiration, but seldom results in a change in career choice.

An outcome of this study is its potential to assist engineering education academics and managers to tailor the forms of support offered for first-generation students. In particular, adjusting support structures to assist students in engaging with the realities of engineering as a profession, and help them in making more informed and well-elaborated decisions in order for them to realise their visions of themselves in the future.

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Appendix

Table 1: Broad areas of questioning in three interviews

Interview 1	**Interview 2**	**Interview 3**
Social context (home, community) of the interviewee	How settled do they feel at university. Do they feel like a student?	What were the exams like? Was it what they expected? Did they seek assistance in preparing for the exams?
Role high school played. Was it something or someone at high school that motivated the interviewee to study further?	Do they think they have changed?	What was the visit to home like? Interaction with family, friends, community
Who/what motivated them to study engineering?	Relationship with family now that at university	What has the first year of study revealed/taught about HE in general and about engineering specifically?
How they feel now that they've actually embarked on their dream (higher education)	Who is the interviewee's go-to person/s (mentor, senior student, fellow student, etc.)	How confident is the interviewee about the 2022 academic year? What specific plans are in place to deal with the year?
Vision: 5 years from now	Vision: 5 years from now – has it changed from 1st interview? If so, what triggered the change?	Do they think they have changed? (as a person, attitude and feeling towards engineering
		Vison: 5 years from now – has it changed from previous interviews? If so, what triggered the change? Is it 'anchored in social reality'?