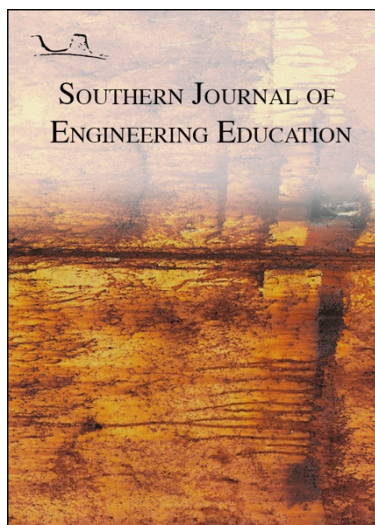




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Becoming engineers over time: longitudinal narratives of educationally disadvantaged chemical engineering students in South Africa

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Becoming engineers over time: longitudinal narratives of educationally disadvantaged chemical engineering students in South Africa

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Research in engineering education has increasingly focused on widening participation and addressing educational disadvantage, yet much of this work relies on short-term, institutionally defined indicators of success, such as time-to-degree completion and immediate graduate employment. As a result, limited attention has been given to how educationally disadvantaged students navigate structural constraints and exercise agency over extended periods, particularly beyond graduation. This paper addresses this gap through a longitudinal narrative study of three chemical engineering students in South Africa, drawing on findings from a published PhD that used interview data collected during the participants' undergraduate studies in 2011, and follow-up interviews conducted 13 years later. Using Margaret Archer's structure-agency framework, the study traces how participants' educational and early-career trajectories unfolded across higher education and into professional practice. The findings show that entry into engineering was shaped less by commitment to the profession than by broader personal projects related to economic security, family responsibility, and upward mobility. None of the participants followed linear pathways; instead, their trajectories involved delay, exclusion, re-entry, and redirection. The transition from university to work emerged as a particularly fragile phase, shaped by unequal access to opportunities, informal networks, and precarious workplace conditions. Over time, participants reconfigured their agency through persistence, strategic action, and shifts in professional identity. The study demonstrates that becoming an engineer is a long-term, negotiated process. It challenges dominant linear notions of success, and highlights the need for policy and institutional approaches that recognise and support diverse, non-linear pathways into engineering practice.

Keywords: Engineering education; educational disadvantage; longitudinal study; student trajectories; graduate transitions

Introduction

Over the past three decades, South Africa's higher education system has undergone significant transformation, driven by a strong policy and research focus on widening participation and improving access for historically marginalised groups, particularly students from previously disadvantaged groups (Council on Higher Education [CHE], 2017; CHE, 2013a). This transformation agenda emerged from the necessity to address deep-seated inequities inherited

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from apartheid-era education policies, which systematically excluded the majority of South Africans from quality higher education (Scott, 2018; Boughey, 2005). Widening participation in engineering education in South Africa has also been influenced by the broader national context, and although it started earlier, it has been deeply shaped by the legacy of apartheid schooling systems and the uneven distribution of educational resources (Case & Jawitz, 2003). Post-apartheid schooling inequalities remain entrenched in South Africa, with mathematics and science education still unevenly distributed across historically advantaged and disadvantaged schools, especially in township and rural contexts. Because the National Senior Certificate subjects mathematics and physical science predict success in engineering, these inequalities continue to shape access and preparedness for engineering (Muyambi & Ahiaku, 2025; Murray, 2016; van Wyk et al., 2015). Although participation among historically disadvantaged groups has increased, significant disparities remain in progression and career outcomes, indicating that equity of access has not translated into equity of success (Sibisi et al., 2025; Schoole & Adeyemo, 2016; Scott, 2018). This raises an important conceptual question about what constitutes success, particularly when students' educational and career trajectories do not follow institutionally prescribed timelines or linear pathways.

One of the key mechanisms to support widening access has been the expansion of the National Student Financial Aid Scheme (NSFAS). To date, the NSFAS remains the main equity-based funding mechanism for poor students, playing a pivotal role in transformation goals within public universities (Mbhalati, 2024; Department of Higher Education and Training, 2018; Letseka, 2013). The emerging challenge for NSFAS-funded students in South Africa centres on the difficulty of transitioning from graduation to stable employment, which affects their overall success. Despite NSFAS's role in increasing access to higher education for disadvantaged students, many graduates, especially those from low-income and rural backgrounds, struggle with unemployment or underemployment, which also impacts their mental health and financial stability (Wildschut et al., 2020; Rakgadi et al., 2025; Matyana, 2023).

Another key intervention to widen access and redress was the introduction of ADPs (Academic Development Programmes), which were designed to provide additional academic support to educationally disadvantaged students (Kloot, 2015; McKenna, 2012; Scott et al. 2007). The introduction of ADPs in South African engineering faculties represents a structural response to students not successfully completing the degrees, and recognition that different

schools, shaped by structural inequalities, provide different levels of preparedness, and that additional time and academic support can be provided to students who do not meet mainstream entry requirements (Mogashana, 2015). These programmes, often extending the standard four-year engineering degree to five years, have enabled increased access for Black African and working-class students (CHE, 2013b). A key study that provides a detailed understanding of the history and role of ADPs in engineering is Kloot (2015), which traces the early years of ADP implementation, first to provide access, and later to address disparities in preparedness and to support students from under-resourced schools. A related study by Heydenrych and Case (2016) looked specifically at the success and contribution of ADPs in chemical engineering at a South African university. However, while ADP interventions have succeeded in widening access, and have contributed to some of the success of students who would not otherwise have gained access to studying engineering, some research points to structural and pedagogical constraints, such as fragmented curricula, compressed exam periods, and negative perceptions from mainstream students and lecturers, which contribute to feelings of marginalisation and exception among ECP students and may limit their academic success (Mogashana et al., 2022; Ogude et. al., 2021).

More broadly, a related body of literature examines persistence, delay, and non-completion in engineering education. Engineering education in South Africa is marked by low completion and high delay, despite strong policy emphasis on STEM (science, technology, engineering, and mathematics) and expanded access (CHE, 2013b). Research points to a mix of academic preparation, first-year performance, mental health, socio-economic factors, and institutional design as drivers of persistence and dropout (Bengesai et al., 2021; Mapaling et al., 2024; Masutha, 2022). Bengesai et al.'s (2021) longitudinal study of engineering students at a South African university found that persistence patterns are influenced by complex interactions between academic performance, financial constraints, and institutional support systems, yet the dominant narrative continues to emphasise individual resilience over structural reform. A study by Mapaling et al. (2024) highlights that patterns of persistence among South African engineering students are influenced by factors such as first-year accumulated credits, admission point scores, race, financial aid, and personal characteristics such as motivation, maturity, self-determination, perseverance, and role modelling. Masutha's (2022) narrative study of Black working-class 'dropouts' in South African higher education challenges dominant deficit framings by illuminating how students are 'pushed out' rather than 'pulled away' from university. The study reveals that non-completion is often the result of institutional failures,

particularly the mismanagement of financial aid schemes, inadequate student housing, and unsupportive academic environments rather than individual shortcomings. The existing literature predominantly ends analysis at the point of dropout or graduation, leaving a significant gap in knowledge about long-term outcomes and alternative pathways to professional engineering practice. Students who take longer than the prescribed duration, interrupt their studies, or exit programmes, are frequently positioned as ‘at risk’ or unsuccessful, with limited attention to what happens beyond the institution (Masutha, 2022).

Within this landscape, success in engineering education is typically measured using institutional indicators such as retention, throughput, time-to-degree, and immediate graduate employment, which reflect a predominantly linear understanding of progression and outcomes. The conventional institutional understanding of success assumes that students enter with stable motivations, progress through programmes within prescribed timeframes, and transition seamlessly into professional practice (Paz, 2025; Splendido et al., 2023; Ahmed, et al., 2015). While these metrics are important for accountability and planning, the existing gap is that they offer a limited view of what it means for students – particularly educationally disadvantaged students in Global South contexts – to become engineers (Blackie et al., 2016). Such assumptions obscure the complexity of students’ lived experiences and risk misclassifying delay, withdrawal, or redirection as failure, rather than recognising these as potential forms of strategic navigation within constrained circumstances (Mogashana, 2015; French et al., 2005). Drawing on literature that distinguishes institutional measures of attainment from subjective, relational, and longer-term understandings of success, this article conceptualises success as a longitudinal, multidimensional, and contextually situated process instead of a single educational or occupational endpoint (Gore, 2025; Inglis et al., 2025; Mkuti & Aucamp, 2024; Sá, 2023; Weatherton & Schussler, 2021). It encompasses educational progression and qualification attainment; transitions into and through employment; professional development; and participants’ pursuit, revision, or realisation of valued personal and professional projects under changing structural conditions. Success is, therefore, understood through both externally observable outcomes, such as graduation, employment, and career progression, and participants’ own interpretations of achievement, progress, redirection, and becoming engineers. This broader conceptualisation does not assume that every delayed, interrupted, or redirected trajectory constitutes success; rather, it avoids treating departure from a linear pathway as evidence of failure.

This is significant given that engineering graduate employability in South Africa remains uncertain. Many graduates, including those funded through NSFAS, experience unemployment or underemployment despite holding engineering qualifications (Wildschut et al., 2020; Rakgadi et al., 2025). Research on the transition from university to work in engineering education has largely focused on employability, graduate attributes, and industry readiness (Trevelyan, 2021). However, in the South African context, this transition is a particularly fragile phase, shaped by unequal access to professional networks, precarious work conditions, and reliance on informal recruitment practices (Masutha, 2022). Moreover, existing research tends to focus on immediate post-graduation outcomes, with limited attention to longer-term career trajectories and professional identity formation (Gardner & Willey, 2018). This limitation is especially important in Global South contexts, where structural constraints such as labour market precarity, economic inequality, and uneven institutional resources result in complex, non-linear pathways into professional practice (Wolff et al., 2025). As a result, relatively little is known about how educationally disadvantaged engineering students navigate their way through challenges and exercise agency over time, particularly at the boundary between higher education and work. There is also a limited understanding of how those who follow non-linear pathways continue to pursue their professional and personal projects over extended periods. This article addresses this gap through an in-depth longitudinal narrative study of three chemical engineering students in South Africa. Drawing on the findings from a PhD thesis that included the initial interviews conducted in 2011 (Mogashana, 2015) and follow-up interviews 13 years later, the article examines how these participants navigated higher education and their subsequent engineering careers over time. In doing so, the analysis considers success not only in whether participants completed their qualifications or entered engineering employment, but also in how they sustained, revised, or redirected their educational, professional, and personal aspirations in response to changing circumstances.

Theoretical framework

Theoretical approaches in engineering education have drawn on concepts such as identity, belonging, capital, and motivation to explain students' experiences (Case & Light, 2011). In addition, social-cultural theories – particularly Bourdieu's concepts of habitus and cultural, social, and economic capital – have been influential in explaining how structural inequalities are reproduced in educational experiences and outcomes (Masutha, 2022). However, examining how students navigate university, transition into the workplace, and progress

through their careers requires a social theory that can account for the interplay between social structure and human agency, while also considering temporality and emergence.

This study draws on Margaret Archer's theory of structure and agency, the morphogenetic approach, to examine the interplay between social structure and human agency. Social structure refers to the material and social relations that condition the situations in which participants find themselves, while agency refers to participants' deliberate intentions and decisions to act and respond within these conditions. A key feature of Archer's approach is analytical dualism and temporality: the idea that structure and agency can be analytically separated over time, allowing their interaction to be examined. Archer (1995, 2003) distinguishes between structural and cultural conditioning by referring to structural and cultural emergent properties (SEPs and CEPs) which are mediated through personal emergent properties (PEPs). These PEPs are exercised through internal conversations, including different modes of reflexivity (Archer, 2007). The morphogenetic approach enables the temporal separation of structure and agency, allowing researchers to trace how agents navigate constraints and exercise agency through reflexive deliberation. It therefore provides a robust framework for analysing the dynamic interplay between structure, culture, and agency over time. Therefore, structure has the power to act on agency by conditioning situations in which agents find themselves. It does not determine action; agents retain the capacity to respond in different ways, thereby activating or transforming structural properties into causal powers (Archer, 1995).

Although the morphogenetic approach has been used sparingly in engineering education research, it has informed two key PhD studies in the Global South context. Mogashana (2015) used this framework to show how students from disadvantaged educational backgrounds, despite being placed in an ADP, exercised different modes of reflexivity to navigate structural and cultural constraints and persist in engineering studies. Similarly, Kotta (2011), focusing on chemical engineering students, found that differential success rates in the Capstone Design Project at a South African university were shaped by both structural and cultural conditioning. These included ineffective pedagogical practices, unclear assessment criteria, and systemic inequities that disproportionately constrained Black students, pointing to the need for institutional reform. Together, these studies demonstrate the value of Archer's framework in explaining how students navigate structural and cultural conditions in engineering education. However, both studies focused on undergraduate experiences and did not extend beyond

completion. As a result, they are silent about how structure and agency interact over longer timeframes, particularly as students transition into professional practice.

This gap is especially significant in the context of the Global South, where educational disadvantage intersects with broader structural inequalities. This study addresses this gap by using Archer's structure–agency framework to trace the 13-year trajectories of three chemical engineering students in South Africa, from undergraduate study into professional practice. It asks: how do educationally disadvantaged chemical engineering students in South Africa navigate structural constraints and exercise agency over time, from university into their professional careers?

Methodology

This study adopts a longitudinal qualitative case study design, drawing on two sets of data collection. The first set is based on a doctoral study conducted in 2011 and published in 2015 (Mogashana, 2015). That study involved 12 undergraduate engineering students enrolled in the fourth year of a five-year Academic Development Programme (ADP). Participants were evenly distributed across four disciplines – Chemical, Civil, Electrical, and Mechanical Engineering – and the study focused on how they navigated their undergraduate trajectories, with particular attention to academic success. Data in the original study were generated through in-depth semi-structured interviews, which invited participants to describe their educational history, experiences within the Academic Development Programme, and responses to the structural and personal conditions that shaped their studies.

The second set consists of follow-up, in-depth semi-structured interviews conducted 13 years later. These interviews were designed to examine the longer-term trajectories of educationally disadvantaged engineering students in South Africa, including their educational pathways, transitions into the labour market, and career progression. Ten of the original participants were successfully traced and re-interviewed. For the purposes of this article, the analysis focuses on three chemical engineering participants, selected through purposive sampling based on the depth and continuity of their longitudinal accounts. The three participants were selected as information-rich cases that provided sufficiently detailed accounts at both time points to support an analysis of continuity, change, and turning points across education and employment. Although the participants shared a disciplinary and programme context, their subsequent educational and career trajectories differed, which enabled

comparison of how similarly positioned students exercised agency under changing structural conditions.

Data were analysed using a longitudinal narrative approach informed by Archer's (2003, 2007) structure–agency framework. Analysis was conducted diachronically, allowing for the tracing of participants' trajectories over time rather than treating interviews as discrete events. This enabled the identification of critical moments, turning points, and shifts in projects and agency in relation to changing structural conditions across higher education and the labour market. The same researcher conducted both sets of data collection. Ethical approval was obtained for the 2024 follow-up study, building on participants' prior consent to be contacted again. Ethical clearance for the follow-up study was granted by the University of Pretoria under protocol number EBIT/8/2024. Although participants in the original study had consented to being contacted for possible follow-up research, fresh written informed consent was obtained before the 2024 interviews, including consent for the longitudinal use and publication of their accounts. Participants were informed that participation was voluntary, that they could decline to answer questions or withdraw from the study, and that their identities would remain confidential. Data from the 2011 study were re-analysed from the approved doctoral thesis, and the original pseudonyms were used throughout to ensure confidentiality and consistency.

Findings

The findings are presented as integrated longitudinal narratives structured across key temporal phases. Rather than presenting each participant separately, the analysis traces their trajectories in parallel, allowing for comparison of how each navigates similar structural conditions over time. This approach allows for the tracing of critical moments, from positioning in the undergraduate programme, leaving the institution, and shifting projects, to the evolving interplay between their personal projects and structural conditioning over time.

Introduction to the participants, what they care about the most, and their structural positioning in the ADP (a period up to the start of 2008)

Ogone grew up in a small mining town near Rustenburg in the North West Province, an area shaped by mining but characterised by poverty and alcohol abuse. Raised primarily by his grandmother, alongside his elder brother, he developed a strong sense of responsibility from an early age, assisting with household duties and remaining closely tied to his family. He

actively distanced himself from peers engaged in alcohol use, explaining that he did not want to associate with ‘drunk’ people, and instead maintained a small, like-minded social circle. While in primary school, Ogone was already aware of and dissatisfied with the poor quality of schooling at the local high school; he thus chose to attend a better-resourced DET (Department of Education and Training) school outside his community, with his commute financially supported by his grandmother and brother. This move enabled him to perform well academically at the distant and better-resourced DET school. After high school, however, Ogone took an unplanned gap year primarily to look after his ailing grandmother. He had not yet thought about what to do beyond that immediate concern for her. Having seen two of his high school classmates studying at university, and with his grandmother's blessing, Ogone decided to apply to university to study engineering. He applied for a bursary from a local mining bursary fund, which would support him financially were he to study engineering. His decision to pursue chemical engineering was shaped by limited career guidance and a desire for upward social mobility, as he understood that ‘engineers were paid a lot of money’. However, over time, his motivations shifted. Rather than being driven primarily by financial gain, his ultimate concern became centred on family and well-being, as he reflected: ‘Like all I see now is that I’m only happy when I’m with my family ... That’s when I feel most happy. That’s what I like the most’. His project to obtain an engineering degree was thus closely tied to his desire to support his family, especially his grandmother. He entered his engineering studies through an ADP and reported difficulty adjusting to the university environment, including the fact that people spoke English, which he was not used to. He expressed discomfort with being placed in what he perceived as a ‘special programme’, as it suggested that the group of students ‘could not do it like other people’. Despite this, the programme did offer some support through connections with students who spoke his home language, although these relationships were not easily sustained.

Dyllon grew up in a township on the Cape Flats in Cape Town, a context he described as ‘violent’ and shaped by ‘gangsterism, lack of information, and bad influences’. Like Ogone, his trajectory was shaped by structural disadvantage, although his family context differed. He came from a ‘tight-knit Christian’ family that placed strong emphasis on education, and despite limited financial resources, his parents invested in his schooling, including paying for private tutoring to support his dyslexia. He attended a dysfunctional high school where teachers ‘would never pitch’, and absenteeism was so normalised that he did not notice when there was a teachers’ strike in his final year – he thought it was a normal day. Nevertheless, he was one of

only two learners in his school cohort to gain admission to university, and the first in his family to do so. Unlike Ogone, who left his home context in pursuit of better schooling and later relocated for university, Dyllon chose to remain close to home, declining an opportunity to pursue military training far from his family. His decision to study chemical engineering at the University of Cape Town was shaped by both pragmatic considerations and institutional reputation, as well as an understanding that the degree would enable upward mobility. His choice to study chemical engineering was based on subject preferences, particularly an interest in mathematics and chemistry. His ultimate concern centred on achieving stability and supporting his family, as he explained: ‘After the [chemical engineering] degree, ultimately I am aiming for a comfortable life, just knowing that you can sufficiently support your family and stuff like that’. His project was thus oriented towards obtaining a degree as a means to secure this future. Like Ogone, Dyllon expressed dissatisfaction with being placed in the ADP, as he wanted to complete his studies ‘as fast as possible’, although he recognised that he had not met the requirements for the mainstream programme. His university experience was further shaped by his daily commute, which limited his participation in campus life and contributed to social isolation. However, he formed connections with other local coloured students in the ADP, with whom he shared a sense of familiarity and belonging.

Tebogo, like Ogone and Dyllon, was the first in his family to attend university, but his early life and schooling trajectory differed in important ways. He grew up in a large township in Bloemfontein and was raised by his mother’s aunt, whom he referred to as his grandmother, following his mother’s death when he was seven. Although he did not have a father figure, his grandmother, a nurse, was able to provide him with relatively stable support and access to better-resourced schooling. In contrast to the disrupted schooling experiences of Ogone and Dyllon, Tebogo attended a private school in his early years and later progressed through Model C schools (largely middle-class schools partially funded by the parent body), culminating in a well-resourced high school. His initial aspirations were not directed towards engineering but towards becoming a commercial pilot, a goal he pursued throughout high school. However, this primary project was constrained by financial limitations, and he described himself as ‘broken’ when he was unable to secure funding for flight training. In the absence of this pathway, he applied to university with limited clarity, noting that he ‘literally went through each and every career’ in the prospectus and was ‘just going with the flow’ when he selected chemical engineering as a secondary option. Like Ogone and Dyllon, his choice of engineering was shaped by pragmatic considerations rather than a strong prior commitment to the field.

Although he was initially accepted into the mainstream programme, his disappointment at not pursuing his preferred career affected his final school performance, resulting in his placement in the ADP. Unlike the discomfort expressed by Ogone and Dyllon, Tebogo appeared relatively indifferent to this placement, indicating that he was primarily focused on progressing through university and maintaining the possibility of pursuing flight school in the future. His ultimate concern centred on achieving a level of financial independence, as he explained: ‘I don’t think of a lavish life; I want to be able to afford what I want ... I don’t want to be filthy rich, but I want to be able to afford [things]’. His project was thus oriented towards completing a chemical engineering degree as ‘something to fall back on’, even though it was not his preferred path and remained a source of frustration.

Navigating the undergraduate studies (2008 to 2011)

Ogone’s early undergraduate trajectory reflects a continuation of the vulnerabilities already evident in his background, particularly his limited prior preparation, social reserve, and strong sense of obligation to family. In his first year, he experienced intense academic and social dislocation resulting mainly from his experience of language barriers, unfamiliar teaching practices, and difficulty with social isolation. He described feeling overwhelmed and questioned his decision to study chemical engineering, noting that ‘maybe I shouldn’t have done chem eng’, especially when his peers seemed to progress more easily. Yet, consistent with his earlier sense of responsibility, he persisted, reasoning that ‘there is no going back ... I just have to manage’. The death of his grandmother in the same year intensified both emotional strain and motivation, prompting him to ‘just work very hard’ and rely entirely on himself. In his second year, Ogone began to reconfigure his approach by stepping out of his ‘comfort zone’ and by forming study relationships with other students. This helped him recognise that other students shared similar struggles. However, his third year marked a critical moment in his journey. Having experienced stigma associated with being an ADP student, losing confidence, and experiencing academic failure, he was at risk of exclusion. Ogone acted strategically and enrolled in a summer school elective to accumulate credits and avoid exclusion. He experienced severe financial hardship, having lost his bursary, including at some point not having accommodation and having to sleep in a lab on campus: ‘I didn’t care what people would think ... I just took my bag and made it my pillow’. By his fourth year, Ogone demonstrated a shift towards more resolute reflexive deliberation for success, actively seeking help and reframing failure as part of the process: ‘if I could survive last year ... then it means I

still have a chance'. His journey shows how his earlier resilience and family-oriented project were reworked into sustained, adaptive strategies under challenging structural constraints.

Dyllon's early undergraduate trajectory builds on the tensions already visible in his background between strong familial support and structurally constrained schooling, as well as the decision to remain at home and commute. He appeared to have adjusted relatively well socially in his first year, having formed friendships with his local peers, but he faced growing academic pressure due to increased workload and the demands of independent learning. His daily commute quickly emerged as a significant constraint, which he described as 'very challenging ... to make the 8 o'clock lecture'. These pressures intensified in his second year, which he identified as his 'most difficult', marked by multiple course failures and academic exclusion. A key issue was his lack of integration into the chemical engineering cohort, limiting his access to academic support, while the commute restricted his ability to remain on campus and engage fully. Despite this setback, he exercised agency by appealing his exclusion, successfully attributing his performance to these constraints. His third year brought further instability, with continued academic struggles and a second academic exclusion, prompting him to consider leaving the university. However, he chose to persist, reasoning that leaving would mean 'you've already been here for three years ... you just wasted three years of your life'. He felt that his only choice was to keep going. By his fourth year, Dyllon reconfigured his approach, most notably by forming a study group with Ogone and others, which enabled collaborative learning and immediate support: 'I can just go to Ogone and David ... and ask'. While he continued to face structural constraints, including a demanding examination timetable, he responded through strategic prioritisation: 'I didn't sleep ... I tried to know what I know for sure'. Dyllon's undergraduate journey indicates a shift from partial adjustment and misalignment to the formation of strategic, fruitful collaborations with other students, even as he, like Ogone, continued to experience institutional marginalisation as an ADP student.

Tebogo's early journey into university indicates the continuation of a key tension identified in his background: the misalignment between his primary aspiration to become a pilot and his secondary project of studying chemical engineering. In his first year, although he experienced initial uncertainty: 'I was just thoroughly shocked in the first lecture ... I was like, what are these?' However, he was not academically overwhelmed and passed all his courses. His main challenge was motivational, as he relied on peer relationships to remain focused on 'something that I don't have a drive for'. In his second year, the loss of these friendships marked a turning

point that weakened his engagement and contributed to academic failure. He acknowledged that he needed others ‘to stay focused’, and without this support, his journey in chemical engineering began to falter. His attempt to reconfigure his situation through social involvement improved his well-being but further hindered his academic progress. In his third year, Tebogo encountered both self-related and institutional constraints, including poor time management and dissatisfaction with assessment practices, particularly the inability to meaningfully review examination scripts. Despite these challenges, he exercised agency and acted strategically by enrolling in elective courses to accumulate credits and avoid exclusion. By his fourth year, continued structural pressures, such as high-stakes assessments, left him ‘defeated for a while’, yet he began to shift towards more active forms of engagement, expressing a desire to challenge institutional practices and ‘raise the real issues’. Throughout this period, his persistence remained anchored in his primary project of becoming a pilot, which continued to shape his orientation to his studies: ‘I want to have my dream before I die’. His trajectory illustrates an ambivalent yet adaptive form of agency as he navigated a path that was never fully aligned with his core aspirations.

Navigating the education–work transition: disruption, delay, and diverging trajectories (2011 to c. 2014)

The period following 2011 marked a critical transition as participants moved out of the university and into the labour market, where new structural conditions came into play. Rather than a linear progression, this phase was characterised by delays, disruptions, and uneven pathways into work. This moment represents a shift from the relatively structured environment of higher education to a more open and uncertain context, in which participants had to reconfigure their projects in relation to changing structural and cultural conditions. For Dyllon, this transition began while he was still completing his degree. Although repeating a chemistry course delayed his academic progression and caused him to add an extra year to his studies, he later reflected that this enabled a deeper engagement with disciplinary knowledge, noting that ‘taking longer to understand what chemical engineers do and how to actually apply all of these concepts, enabled me to walk into my first job’. This delay can be understood as a form of temporal extension that strengthened his agency, particularly for practical competence and confidence. Drawing on his reflexive deliberation, Dyllon exercised his agency to secure his first employment, an internship, by directly approaching a company. As he explained: ‘I walked into reception ... and I said, ‘Look, this is my situation ... they were like it’s fine, you

can start before graduation'. He proactively exercised agency to strategically deal with a potentially constraining structural condition of a delayed graduation, thus circumventing the conditions that would have delayed his entry into the working world.

Ogone's transition into the workplace followed a more conventional sequence but was shaped by constraining structural conditions. After graduating in 2013, he struggled to access formal graduate opportunities. He secured a graduate training position at a mine in the Mpumalanga province through informal networks, illustrating the role of social networks in mediating access to work. However, the workplace environment introduced new structural and cultural constraints that conflicted with his personal concerns and emerging sense of self. He described being told by a supervisor that he would be their 'slave' for two years, an experience that reflected a dehumanising workplace culture. In response, Ogone weighed his options, engaged in reflexive deliberation, and exercised his agency by choosing to resign after approximately four months, far earlier than the 24-month graduate training programme. He was aware of the potential long-term implications of this decision, noting that employers would question why 'you had a two-year graduate programme, and you left it. Why did you leave it?' He decided to resign and used the need to study further as the primary motivation for his resignation. This motivation can be understood as an assertion of agency in response to oppressive structural conditions, as he prioritised dignity and well-being over compliance. He went on to study for his Master's in chemical engineering at another university, a period marked by further constraints, including having to supervise himself through the project. When he finished and graduated, he resumed what became a challenging job search that eventually led him to work for a company for free for the first few months.

Tebogo's trajectory diverged most sharply from Ogone and Dyllon. Following his academic exclusion from chemical engineering at the end of his fourth year (the year when he was first interviewed), he pursued an alternative chemical engineering diploma pathway at a nearby university of technology in Cape Town. Completing the diploma required that he complete in-service training. However, his transition into the workplace was constrained by multiple intersecting challenges. Unlike Dyllon, who was able to leverage initiative to enter work early, and Ogone, who accessed opportunities through networks, Tebogo struggled to secure placement. He explained that 'I needed to work now ... I struggled to find work placement ... I'm no longer a full-fledged student ... I now don't have proper funding', highlighting the compounded pressures of financial insecurity and institutional displacement.

After several unsuccessful attempts to secure employment, he returned to his home province due to a lack of resources, stating, ‘I had to go back home ... because I no longer [had] funds and I didn’t have work’.

Becoming engineers over time: reorientation, persistence, and evolving trajectories (up to 2024)

Over the longer term, the participants’ trajectories reflected persistence, reorientation, and professional formation that extended beyond institutional timelines. Building on the uneven transitions described earlier, this phase shows how participants reconfigured their projects in response to shifting structural conditions in the labour market. For Dyllon, the early, proactive agency he demonstrated by entering work before graduation translated into a more stable, cumulative trajectory. After leaving the tyre-recycling company where he was employed, he moved into water treatment during Cape Town’s drought, where he began to connect disciplinary knowledge with practice, noting: ‘membranes ... I read about them ... this is mass transfer’. This reflects a growing alignment between his undergraduate chemical engineering training and workplace demands for such in-depth knowledge. Over the years, his role expanded within a small engineering consulting firm, where he progressed from a process engineer to a senior engineer and to business management. As he explained, ‘We started ... three engineers. Now we’re about six engineers’, indicating both organisational growth and his increasing responsibility. He had been their first engineer, and his presence had expanded this part of the company. Despite his challenges and the prolonged duration of his undergraduate degree, which he completed after seven years, Dyllon had found his place in the workplace. Through strategic exercise of agency over time, he had consolidated his position in the field and was now a thriving leader.

Ogone’s trajectory, by contrast, having taken six years to complete a five-year programme, reflects a more disrupted pathway followed by deliberate reorientation. After leaving his initial graduate placement, as indicated earlier, he returned to study, then faced prolonged periods of unsuccessful job searching, describing how ‘you send out applications and receive no acknowledgement at all’. Rather than withdrawing, he adopted a more assertive strategy to enter the labour market. He approached an engineering consulting firm in person and offered to work without pay to demonstrate his capability, stating: ‘I was willing to work for free ... for three months without pay’. This moment represents a significant reconfiguration of agency, as he actively created an opportunity in the absence of enabling structures. During this period, he

initiated work on waste-tyre pyrolysis, which later developed into a more substantial role. Reflecting on this trajectory, he noted that ‘together with the CEO, we founded the engineering division’, indicating a shift from marginal entry into a position of influence in the company. Compared to his earlier experience of a hostile mining workplace, this phase reflects a reorientation towards an environment that aligned more closely with his values and sense of self. He has worked for this company since his early entry on a three-month work-for-free probation basis. Despite his challenges in transitioning to the labour market, Ogone had now found himself settled in a place where he was making a significant contribution and using some of his financial and time resources to uplift others in his home community.

Tebogo’s trajectory continued to diverge in complicated ways, illustrating recovery through redirection rather than continuity within chemical engineering. After being unable to secure in-service training in Cape Town and deciding to return to his home province, he later secured in-service training at a large beverage company. However, his journey to complete his in-service training in chemical engineering had to be abandoned when the professional engineer supervising him resigned six months after he began. This breakdown removed a key structural support required for progression, leaving him without a clear route to qualification. In contrast to Dyllon’s consolidation within the field and Ogone’s strategic re-entry, Tebogo was forced to reconsider his trajectory more fundamentally. It was within this context of uncertainty that a chance interaction with someone he met at the beverage company prompted a decisive shift away from chemical engineering towards starting afresh to study Civil Engineering at a nearby University of Technology. As he recalled: ‘We just had a random conversation... [he said] “just go there and apply”’. This moment represents a turning point in which his project was reconfigured, not through long-term planning but through opportunistic adaptation in response to constrained circumstances. He qualified for NSFAS funding; however, luck was on his side as he was able to secure better and more sustainable funding from a government department. Starting afresh was a tough decision, but one that seemed to have freed him from the shackles of chemical engineering. His grandmother had reservations about his decision, but Tebogo was determined to prove to her that he could make something out of what could be perceived as an unstable pathway. He completed his Civil Engineering diploma at the top of his class, secured in-service training in Cape Town, secured a full-time job there, and returned to his hometown to complete his Bachelor of Technology degree. Access to opportunities remained mediated by informal and relational forms of capital rather than formal structures. As he explained, ‘I got the job ... because I had a good relationship with the receptionist’, highlighting how seemingly

peripheral relationships became critical in enabling movement. Over time, his trajectory reflects a gradual redefinition of his professional identity, moving away from both his initial aspiration to become a pilot and his later engagement with chemical engineering. Although he is older, his dream of becoming a pilot has not died. As he stated, ‘I’d never thought of myself as going to be a chemical engineer’, indicating how his pathway ultimately led to a different, but nonetheless viable, professional outcome in Civil Engineering. At the time of the final interview, Tebogo had secured permanent employment and was in the final stages of his master’s studies. His case illustrates how trajectories may be reshaped through a combination of constraint, contingency, and adaptive agency, resulting in forms of professional becoming that diverge significantly from initial plans.

Discussion

This study set out to examine how educationally disadvantaged chemical engineering students in South Africa navigate structural constraints and exercise agency over time, particularly across the transition from higher education into professional practice. By adopting a longitudinal narrative approach and drawing on Archer’s structure–agency framework, the study addresses a gap in the literature: the limited understanding of students’ trajectories beyond institutional timelines and linear measures of success (Gardner & Willey, 2018). The findings demonstrate that the research question may be answered not through static indicators of success, but by tracing how participants’ projects evolve, the constraints they encounter in pursuing them, and the ways in which they exercise agency over time.

Across the three cases, entry into engineering was not driven primarily by a stable commitment to the profession, but by broader personal projects linked to upward economic mobility, family responsibility, and future security. This aligns with existing work that highlights how students from disadvantaged backgrounds engage higher education as a means to achieve wider life goals. However, the findings extend this insight by showing how these projects are not fixed; rather, they are reconfigured over time as participants encounter new structural conditions. Tebogo’s trajectory, in particular, illustrates how an initial misalignment between personal aspirations and one’s chosen field can lead to redirection, rather than failure.

The undergraduate phase reveals how structural and cultural constraints, such as inadequate academic preparation, marginalisation within ADPs, and institutional practices like compressed assessment schedules, shape students’ experiences in ways consistent with

previous South African studies (Mogashana et al., 2022). However, rather than positioning delay and difficulty as indicators of failure, the findings show how students exercise agency in diverse ways, including persistence, strategic course selection, and the formation of peer networks. These actions reflect reflexive engagement with constraint, supporting Archer's (2003) argument that social structure does not act by determining the actions of agency, but by conditioning the situation in which students and graduates still need to deliberate and choose their actions.

The transition from university to work emerges as a particularly fragile and uneven phase, confirming concerns raised in the literature about graduate employability and labour market precarity in South Africa (Rakgadi et al., 2025; Masutha, 2022). Participants' pathways into work were shaped by unequal access to networks, informal recruitment practices, and workplace conditions, including instances of exploitation. Importantly, the findings show that agency during this phase often takes unconventional forms, such as Dyllon's direct approach to seek his first internship at a tyre recycling company and Ogone's willingness to work unpaid to gain entry into the workplace. These actions highlight how graduates actively exercise agency to navigate constrained labour markets, rather than passively awaiting opportunities.

Over the longer term, the findings challenge dominant linear understandings and assumptions of engineering education success. None of the participants followed a straightforward trajectory from entry to graduation to stable employment. Instead, their pathways were characterised by delay, exclusion, re-entry, and redirection, yet all three ultimately achieved forms of professional positioning. This supports arguments that traditional metrics such as time-to-degree and immediate employment provide a limited account of success (Paz, 2025; Splendido et al., 2023). From Archer's (1995) perspective, these trajectories can be understood as morphogenetic processes in which agency is transformed, and projects are continuously reconfigured in response to changing structural conditions.

Taken together, the study highlights that becoming an engineer is a temporally extended and socially situated process. It involves ongoing negotiation between structure and agency, where success is not defined by adherence to institutional timelines, but by the capacity to sustain and adapt one's projects over time. In the Global South context, where structural inequalities are pronounced, this perspective is particularly important for reframing how success, persistence, and failure are understood in engineering education. These findings imply that engineering education research and institutional evaluation should adopt a longer-term

view of student trajectories, distinguishing delayed, interrupted, or redirected pathways from permanent disengagement or failure. Longitudinal approaches can make visible forms of persistence, professional development, and eventual participation in engineering practice that conventional throughput and immediate-employment measures may obscure.

Conclusion

This study has shown that the pathways of educationally disadvantaged engineering students are complex, non-linear, and shaped by ongoing interactions between structural conditions and evolving forms of agency. By tracing three longitudinal trajectories over 13 years, the findings demonstrate that becoming an engineer extends far beyond institutional measures of success and involves processes of persistence, reorientation, and adaptation. The study contributes a Southern, longitudinal perspective that challenges dominant linear narratives in engineering education and calls for a broader understanding of success, one that recognises delayed, redirected, and uneven pathways as legitimate forms of professional development. However, the study is limited by its small, purposively selected sample and its focus on a single discipline within a single national context, which may limit its broader applicability to other contexts. Future research could extend this work by examining larger, more diverse cohorts across engineering disciplines and institutional contexts, as well as through comparative studies in Global South settings. The findings have important implications for policy and practice. At a policy level, there is a need to move beyond narrow success indicators such as time-to-degree and immediate employment, towards measures that account for long-term, non-linear trajectories. At an institutional and practice level, universities and employers must better support transitions beyond graduation through sustained career support, inclusive recruitment practices, and recognition of diverse entry pathways. Ultimately, the study shows that without rethinking how success is defined and supported, current systems risk misrecognising persistence as failure and overlooking the full potential of engineering graduates.

References

- Ahmed, N., Kloot, B., & Collier-Reed, B. I. (2015). Why students leave engineering and built environment programmes when they are academically eligible to continue. *European Journal of Engineering Education*, 40(2), 128–144. <https://doi.org/10.1080/03043797.2014.928670>
- Archer, M. S. (1995). *Realist social theory: The morphogenetic approach*. Cambridge University Press.
- Archer, M. S. (2003). *Structure, agency and the internal conversation*. Cambridge University Press.
- Archer, M. S. (2007). *Making our way through the world: Human reflexivity and social mobility*. Cambridge University Press.
- Blackie, M., le Roux, K., & McKenna, S. (2016). Possible futures for science and engineering education. *Higher Education*, 71(6), 755–766. <https://doi.org/10.1007/s10734-015-9962-y>
- Bengesai, A. V., Mhlono, S., & Ngcobo, T. (2021). Patterns of persistence among engineering students at a South African university. *South African Journal of Science*, 117(3/4), 1–10. <https://doi.org/10.17159/sajs.2021/7712>
- Boughey, C. (2005). Epistemological access to the university: An alternative perspective. *South African Journal of Higher Education*, 19(3), 230–242. <https://doi.org/10.4314/sajhe.v19i3.25509>
- Case, J. M., & Jawitz, J. (2003). Educational paradigms and engineering educators in South Africa. *Higher Education*, 45(3), 257–276. <https://doi.org/10.1023/A:1022481907165>
- Case, J. M., & Light, G. (2011). Emerging research methodologies in engineering education research. *Journal of Engineering Education*, 100(1), 186–210. <https://doi.org/10.1002/j.2168-9830.2011.tb00008.x>
- Council on Higher Education. (2013a). *White paper for post-school education and training*. Department of Higher Education and Training. <https://www.che.ac.za/publications/legislation/white-paper-post-school-education-and-training>.
- Council on Higher Education. (2013b). *A proposal for undergraduate curriculum reform in South Africa: The case for a flexible curriculum structure*. http://www.che.ac.za/sites/default/files/publications/Full_Report.pdf.
- Council on Higher Education. (2017). *VitalStats: Public Higher Education 2015*. https://www.usaf.ac.za/wp-content/uploads/2017/10/CHE_VitalStats_Public-Higher-Education-2015.pdf.
- Department of Higher Education and Training. (2018). *NSFAS annual report 2017/2018*. Government Printer. Retrieved from: <https://www.nsfas.org.za/content/reports/AnnualReport2018.pdf>.
- French, B. F., Immekus, J. C., & Oakes, W. C. (2005). An examination of indicators of engineering students' success and persistence. *Journal of Engineering Education*, 94(4), 419–425. <https://doi.org/10.1002/j.2168-9830.2005.tb00869.x>

- Gardner, A., & Willey, K. (2018). Academic identity reconstruction: The transition of engineering academics to engineering education researchers. *Studies in Higher Education*, 43, 234-250. <https://doi.org/10.1080/03075079.2016.1162779>
- Gore, O. T. (2025). Dimensions of student success in universities in South Africa: Students' perspectives. *Journal for New Generation Sciences*, 23(1), 116–129. <https://doi.org/10.47588/jngs.2025.23.01.a9>.
- Heydenrych, H., & Case, J. M. (2015). Academic development in the mainstream: A case study in an undergraduate engineering programme in South Africa. *South African Journal of Higher Education*, 29(5), 179–200. <https://hdl.handle.net/10520/EJC182511>.
- Inglis, H., Matemba, E., & Mogashana, D. (2025, September 17–21). *The importance of diverse economic contexts in African student success* [Conference presentation]. Proceedings from the International Research Symposium on Problem-Based Learning (IRSPBL). <https://doi.org/10.54337/irspbl-11089>.
- Kloot, B. C. (2015). A historical analysis of academic development using the theoretical lens of Pierre Bourdieu. *British Journal of Sociology of Education*, 36(6), 958–975. <https://doi.org/10.1080/01425692.2013.868785>.
- Kotta, L. T. (2011). *Structural conditioning and mediation by student agency: A case study of success in chemical engineering design* [Doctoral thesis]. University of Cape Town. <http://hdl.handle.net/11427/11475>.
- Letseka, M. (2013). *Student retention and graduate destination: Higher education and labour market access and success*. HSRC Press.
- Mabokela, R. O. (2021). Equity and access to higher education twenty-five years later: A review of enrollment, graduation and employment trends in South African universities. In A. Fomunyan (Ed.), *Higher education in the next decade* (pp. 149–164). Brill. https://doi.org/10.1163/9789004462717_009.
- Matyana, M. (2023). Evaluation of the National Student Funding Aid Scheme (NSFAS) policy in South African universities: Implications and challenges. *JISR Management and Social Sciences & Economics*, 1(1), 1–16. <https://doi.org/10.31384/jisrmsse/2023.21.4.1>.
- Mapaling, C., Mokoena, S., & Nkosi, B. (2024). Diverse perceptions among engineering students and staff of the factors affecting student success. *South African Journal of Higher Education*, 38(4), 1–20. https://hdl.handle.net/10520/ejc-high_v38_n4_a9.
- Masutha, M. (2022). Highs, lows and turning points in marginalised transitions and experiences of noncompletion amongst pushed dropouts in South African higher education. *Education Sciences*, 12(9), 608. <https://doi.org/10.3390/educsci12090608>.
- McKenna, S. (2012). The context of access and foundation provisioning in South Africa. In A. Dhunpath & R. Vithal (Eds.), *Alternative access to higher education: Underprepared students or underprepared institutions?* (pp. 51–61). Pearson.
- Mbhalati, O. (2024). Access, equity and redress: Towards a sustainable funding framework for public universities in South Africa. *Review of Education*. 12, e3449. <https://doi.org/10.1002/rev3.3449>.
- Mkuti, S., & Aucamp, E. (2024). Contextualising the South African higher education academic interventions for student success: Challenges and opportunities. *International*

- Conference on Education Research*, 1(1), 185–192. <https://doi.org/10.34190/icer.1.1.3108>.
- Mogashana, D. (2015). *The interplay between structure and agency: How academic development programme students 'make their way' through engineering education* [Doctoral thesis]. University of Cape Town. <https://open.uct.ac.za/handle/11427/16601>.
- Mogashana, D., Case, J., & Williams, K. (2022). How ADP students navigate enablements and constraints of the programme: An exploration of structure and agency. *South African Journal of Higher Education*, 36(2), 166–184. <https://doi.org/10.20853/36-2-4698>.
- Murray, M. (2016). Does poor quality schooling and/or teacher quality hurt Black South African students enrolling for a degree at the University of KwaZulu-Natal? *PLOS ONE*, 11(4), Article e0153091. <https://doi.org/10.1371/journal.pone.0153091>.
- Muyambi, G. C., & Ahiaku, P. K. A. (2025). Inequalities and education in South Africa: A scoping review. *International Journal of Educational Research Open*, 8, Article 100408. <https://doi.org/10.1016/j.ijedro.2024.100408>.
- Ogude, N., Majozi, P., Mathabathe, K., & Mthethwa, N. (2021). The management of student success in extended curriculum programmes: A case study of the University of Pretoria's Mamelodi Campus, South Africa. *South African Journal of Higher Education*, 35(4), 178–198. <https://doi.org/10.20853/35-4-4242>.
- Paz, H. R. (2025). The stagnant persistence paradox: Survival analysis and temporal efficiency in exact sciences and engineering education. *arXiv*. <https://arxiv.org/abs/2512.04828>.
- Rakgadi, P., Azwidowi, M., & Chika, S. (2025). Challenges and experiences of NSFAS-funded students after completing their studies. *Mitteilungen Klosterneuburg*, 75(2), 2–20. <https://doi.org/10.61586/iv40v>.
- Sá, M. J. (2023). A multidimensional model of analysis of students' global experience in higher education. *Education Sciences*, 13(3), Article 232. <https://doi.org/10.3390/educsci13030232>.
- Scott, I., Yeld, N., & Hendry, J. (2007). *A case for improving teaching and learning in South African higher education*. Higher Education Monitor No. 6. Council on Higher Education.
- Scott, I. (2018). Designing the South African higher education system for student success. *Journal of Student Affairs in Africa*, 6(1), 1–17. <https://doi.org/10.24085/jsaa.v6i1.3062>.
- Schoole, C., & Adeyemo, K. S. (2016). Access to, and success in, higher education in post-apartheid South Africa: Social justice analysis. *Journal of Higher Education in Africa / Revue de l'enseignement supérieur en Afrique*, 14(1), 1–18. <http://www.jstor.org/stable/90016098>.
- Sibisi, N., Jokazi, S., Lefalatsa, L., Mamabolo, J., Dienga, A., & Nkhumise, B. (2025). Gender disparities in science, technology, engineering, and mathematics (STEM): A review of challenges and inclusion strategies in South Africa. *Perspectives in Education*, 43(4), 341–363. <https://doi.org/10.38140/pie.v43i4.9442>.

- Splendido, S., Gregg, A., & Berdanier, C. (2023, June 25–28). Student success in 4-D (SS4D): Toward a holistic understanding of engineering student success in motivation, curricular attainment and experiential opportunities across educational stages [Conference presentation]. *Proceedings of the 2023 ASEE Annual Conference & Exposition*. <https://doi.org/10.18260/1-2--44327>.
- Trevelyan, J. (2021). *Learning engineering practice*. CRC Press.
- Weatherton, M., & Schussler, E. E. (2021). Success for all? A call to re-examine how student success is defined in higher education. *CBE—Life Sciences Education*, 20(1), Article es3. <https://doi.org/10.1187/cbe.20-09-0223>.
- Wildschut, A., Rogan, M., & Mncwango, B. (2020). Transformation, stratification and higher education: Exploring the absorption into employment of public financial aid beneficiaries across the South African higher education system. *Higher Education*, 79, 961–979. <https://doi.org/10.1007/s10734-019-00450-z>.
- Wolff, K., Hattingh, T., & Smith, L. (2025). Global challenges, local responses: Exploring curriculum reform in South African engineering education. *Journal of Engineering Education Transformation*, 38(2), 1–15. <https://doi.org/10.1002/jee.70006>.
- van Wyk, B. J., Hofman, W. A. H., & Louw, I. (2015). Impact of mathematics and physical science on the success of South African engineering technology students. *International Journal of Engineering Education*, 31(4), 1158–1166.
- Zezeza, P. T. (2016). The transformations of higher education in Africa. *Journal of Higher Education in Africa*, 14(1), 1–20.