Education Research in African Contexts

Traditions and New Beginnings for Knowledge and Impact

Edited by
Paul Webb, Mathabo Khau and
Proscovia Namubiru Ssentamu

AFRICAN MINDS

Published in 2024 by African Minds
4 Eccleston Place, Somerset West, 7130, Cape Town, South Africa
info@africanminds.org.za | www.africanminds.org.za

ISBN (paper): 978-1-0672535-0-9
eBook edition: 978-1-0672535-1-6
ePub edition: 978-1-0672535-2-3

Copies of this book are available for free download at: www.africanminds.org.za

ORDERS:
African Minds
Email: info@africanminds.org.za
To order printed books from outside Africa, please contact:
African Books Collective
PO Box 721, Oxford OX1 9EN, UK

Email: orders@africanbookscollective.com

CHAPTER 3
A quantitative study on academic resilience among engineering students at a South African university

Curwyn Mapaling, Paul Webb, Belinda du Plooy

Background

Existing literature acknowledges the concept of academic resilience as critical to student success, particularly in challenging fields such as engineering, where some of the highest drop-out and lowest through-put rates have been observed. However, empirical research on resilience remains scarce, particularly in African contexts and specifically within South Africa. Furthermore, the majority of these studies have relied predominantly on qualitative methodologies. The use of quantitative methods in exploring academic resilience, especially within the South African engineering education environment, is not well-documented.

Theoretical perspectives on student academic resilience

In the pursuit of a comprehensive understanding of academic resilience, this literature review will delve into both established metrics and student perceptions. While the use of specific measures offers rigorous, data-driven insights, it is equally crucial to examine how students themselves conceptualise resilience. Thus, this literature review provides a nuanced perspective that complements the quantitative data presented later in this chapter, thereby enriching our overall understanding of academic resilience. Including literature on student perspectives serves to contextualize the subsequent quantitative results.

In an insightful exploration by Carnell et al. (2020), the intricate relationship between academic performance, the independent variable measured through improved grades, and students' perceived satisfaction, the dependent variable, was investigated amongst engineering students. The examination unfolded by administering detailed questionnaires following the first mid-term in a sophomore engineering statics course, aiming to reveal any inherent correlations between the independent and dependent variables. To obtain a well-rounded perspective, a Likert scale survey was implemented, alongside open-ended questions. This methodological approach garnered quantitative data and qualitative insights regarding the students' satisfaction levels, allowing for a detailed interpretation of students' subjective feelings and perceptions related to their academic results.

A cohort of 95 engineering undergraduates was engaged in a reflective analysis of their academic performance for a duration of four weeks prior to participating in the survey. To synthesise the findings effectively, levels of satisfaction were classified into low, moderate, and high categories. Instances revealing a discrepancy between satisfaction and performance, coined as 'off diagonals', were subjected to meticulous analysis. This examination uncovered a range of attributions to underperformance, from external contributors like time constraints and course structure to internal ones. It was observed that students who related their underperformance to external factors experienced heightened stress levels. Conversely, students whose grades improved more than their indicated levels of satisfaction usually accentuated internal elements and harboured positive perspectives towards self-betterment. This mixed-method approach, scrutinising academic accomplishments through improved grades and assembling qualitative perceptions of satisfaction, clarified the complex interplay between objective academic achievements and subjective student experiences, offering profound insights into the dimensions of academic resilience and adaptability within educational settings.

A South African study by Campbell et al. (2021) underscored the role of mindset in engineering students' resilience. Those who dropped out were found to possess a 'fixed mindset,' believing their intelligence was immutable. This mindset increased their vulnerability to academic challenges (Campbell et al., 2021). On the other hand, those with a 'growth mindset'—believing that effort could improve their intelligence—were more resilient (Campbell et al., 2021).

The highly competitive nature of engineering studies can also generate stress, as pointed out by Downs and Eisenberg (2012). The prevailing culture in engineering academia often equates stress with normalcy, which can dissuade students from seeking mental health treatment (Downs & Eisenberg, 2012). This portrayal of stress as an inherent trait of engineering students can harm both existing and future students. Newcomers may feel compelled to adopt this stress culture, perpetuating a misleading academic environment (Downs & Eisenberg, 2012). Other studies have found that students with preexisting high stress, anxiety, or lack of support were more vulnerable to developing anxiety disorders (Bantjes et al., 2020; Macgeorge et al., 2005).

Cross (2018) examined the Engineering Stress Culture (ESC) by employing self-administered surveys focusing on stress and anxiety metrics. The study revealed that a substantial proportion of students suffered from mental health issues: 22.4% experienced moderate to severe stress, 29.9% endured moderate to severe anxiety, and an equal percentage showed signs of moderate to severe depression (Cross, 2018). Gaining insights into how students interpret stress can inform the creation of targeted interventions to alleviate stress, thereby contributing to student recruitment, retention, and overall success (Cross, 2018).

Bennett et al. (2014) explored a somewhat neglected area of research concerning how engineering students, both domestic and international, perceive their career prospects and personal attributes. Surveying over a thousand first-year engineering students in Australia, the study found that both groups valued qualities like ethical conduct, communication skills, creativity, professionalism, and teamwork in engineers. Interestingly, 'orderly management' was highly valued among Australian students, whereas 'intelligence' topped the list for international students (Bennett et al., 2014). When asked to self-assess based on these qualities, international students rated themselves lower in eight of the nine identified traits (Bennett et al., 2014). While this might suggest lower self-esteem among international students, it could also be reflective of cultural and educational differences (Bennett et al., 2014). For example, 49% of the sample comprised international students who were non-native English speakers, underlining the necessity for engineering curricula to incorporate English language proficiency modules (Bennett et al., 2014). The one area where international students felt confident was in intelligence, a trait that Willingham (2021) notes is generally considered fixed in Western cultures but more flexible in Eastern perspectives.

In addition to academic pressures, engineering students face a range of external challenges that further complicate their educational journey, including language barriers, faculty shortages, financial constraints, limited industry exposure, and employability concerns (Danta, 2023).

Language barriers: Language proficiency can present significant obstacles in engineering education, which is predominantly taught in English. This can adversely impact students who are not native English speakers, affecting not just their academic performance but also their self-confidence and societal integration (Gerwel Proches et al., 2018; Peled, 2017; Feinberg et al., 2021). A United States-based study revealed that over 75% of respondents identified English as their first language, a sharp contrast to South Africa where only a small minority speak either of the two primary languages of instruction—English and Afrikaans—as their first language (Cross, 2018).

Staff shortages: A dearth of qualified faculty plagues engineering programmes, especially in India. Both public and private institutions are impacted, leading to compromised education quality (Alva, 2018; Danta, 2023). The issue is also prevalent in South Africa, losing skilled engineers to emigration at an alarming rate (Staff Writer, 2019).

Financial constraints: High tuition and additional expenses form a significant barrier to engineering education. Financial hardships disproportionately affect students from lower socio-economic backgrounds, making engineering degrees particularly elusive for this demographic (Danta, 2023; Goodier, 2019; Cross, 2018). Although student loans offer a temporary respite, they lead to a burgeoning crisis

of student debt, particularly affecting minority communities in the United States (Hanson, 2021).

Limited industry interaction: Many engineering curricula emphasise theoretical aspects over practical, industry-relevant skills. This lack of real-world exposure creates a skills gap in engineering graduates, leaving them less prepared for employment (Danta, 2023; Gero et al., 2017).

Employability concerns: The competitive job market in engineering poses its own set of challenges. Foreign engineers willing to accept lower salaries exacerbate employment difficulties for local graduates. In the U.S., the manufacturing sector is the largest employer of engineers, highlighting the field's competitiveness (Leibbrandt, 2010; Torpey, 2018). In South Africa, the lack of skilled engineers makes these positions especially hard to fill (Bengesai & Pocock, 2021).

The transition to online distance learning (ODL) has added another layer of complexity to engineering students' perceptions of their academic resilience and challenges. The shift to online learning due to the COVID-19 pandemic has been met with mixed reviews (Wang, 2014; Saidalvi et al., 2021). For instance, Mathew and Chung (2020) sampled 608 university students in Malaysia and found diverging opinions on ODL, attributed primarily to resource limitations and poor internet connectivity. Another Malaysian study echoed a generally positive reception of online learning, citing factors like enthusiasm, self-efficacy, and satisfaction (Sim et al., 2021).

Similarly, in a study conducted among 360 Ghanaian international students, the majority found online learning beneficial and effective (Demuyakor, 2020). Indian students in Delhi also reported benefits such as a greater sense of freedom and increased connection with teachers (Khan et al., 2020). On the flip side, some students have found the transition to online learning frustrating, challenging to adapt to, and potentially a reason to withdraw from their academic programmes (Saidalvi et al., 2021; Song et al., 2004). Factors influencing these drop-out risks include poor home learning environments, technical issues, and lack of resources.

The conflicting findings from various studies point to the complicated nature of ODL readiness across different contexts. For instance, while one study claimed that Malaysia was prepared for the online shift due to the availability of necessary gadgets among students, another study argued the opposite, especially for students in rural areas (Saidalvi et al., 2021; Yeoh, 2020).

Although research has extensively examined resilience and challenges faced by engineering students, there has been a notable gap in capturing students' own perceptions of their academic experiences (Bennett et al., 2014). By exploring these perceptions across various academic domains, this review aims to shed light on influential factors like mindset, academic performance, satisfaction, and challenges, thereby contributing to a deeper understanding of engineering students' experiences. The next section will outline the aim of the study.

Aim of the study

Recognising a gap in the existing literature on academic resilience among engineering students in Africa, and more specifically within the South African higher education context, this research was designed to describe and correlate the resilience characteristics of final-year students in the Bachelor of Engineering Technology (BET) programme at Nelson Mandela University. While this chapter is a subset of a broader mixed-method investigation into resilience (Mapaling, 2023), it emphasises the quantitative aspects of the research, offering a distinct contribution to the current understanding of resilience in engineering education. In particular, the objective of the quantitative phase of the broader study was to contextualize the academic resilience of engineering students in South African higher education.

Methodology

Research design

In alignment with the criteria of an exploratory case study (Yin, 2018), this study employed a mixed-method approach involving both quantitative and qualitative data generation techniques, executed in two consecutive phases. It should be noted, however, that this chapter focuses solely on the quantitative results; the qualitative insights have been comprehensively explored in previous publications (Mapaling et al., 2021, Mapaling et al., 2022, Mapaling et al., 2024).

Participants and setting

The study utilized a purposive sampling method, enrolling 66 final-year students from the BET programme. Out of these participants, 47 successfully completed the full set of four measuring instruments that were administered in the study. This sample accounted for approximately 74.6% of the graduating BET class of 2020, which originated from the first admission cycle in 2018. The research took place at Nelson Mandela University, an institution with a dual focus on academic and vocational training, located in South Africa's Eastern Cape region.

Measuring academic resilience: Instruments for risk and resilience

Risk

Diagnostic and Statistical Manual of Mental Disorders Fifth Edition Self-Rated Level 1 Cross-Cutting Symptom Measure-Adult (DSM-5 CCSM-A; American Psychological Association, 2013)

The DSM-5 CCSM-A is a self-report scale developed by the American Psychiatric Association for trans-diagnostic mental health assessment. Employed in the current case study, the adult version includes 23 questions across 13 domains such as depression, anxiety, and substance use. Respondents use a 5-point Likert scale to

indicate symptom experience over the past two weeks, with scores of 2 or higher in most domains indicating clinical relevance.

This tool has primarily been validated in clinical settings. However, Bravo (2018) extended its application to a non-clinical population of 7,217 university students across the U.S., using matrix sampling. The study supported the DSM-5 CCSM-A's internal, convergent, and criterion-related validity for assessing psychopathology among university students.

The Kessler Psychological Distress Scale (K10; Kessler et al., 2002)

The K10, a 10-question Likert scale instrument, screens for psychological distress, particularly anxiety and depression. Scores range from 10 to 50, and the tool is commonly used both clinically and in general populations.

In an Australian national survey by Andrews et al. (2001), 10,641 adults participated, revealing a mean K10 score of 14.2. The study showed a strong correlation between K10 scores and clinical diagnoses of anxiety and affective disorders, suggesting the tool's clinical utility. Yet, appropriate cut-off scores for clinical decision-making remain to be clarified.

Chiara et al. (2021) employed the K10 among 261 foreign students in South Korea. The study found that high K10 scores were linked to elevated psychological distress levels, with a satisfactory internal reliability score of 0.89. Nearly 30% of these students reported high distress, and the study identified certain sociodemographic factors linked to elevated distress.

In Pakistan, Qamar et al. (2014) used the K10 to assess 405 medical students. The study classified stress levels into mild, moderate, and severe categories, with an average stress score of 19.61. About 42% of the sample reported some level of stress, but the data did not show a significant association between stress and academic year. Both studies contribute to the broader application of the K10 as an effective tool for evaluating psychological distress in educational settings.

Resilience

The Adult Resilience Measure (ARM-28; Resilience Research Centre, 2018)

The ARM-28 is an adaptation of the CYRM-R-28 (Resilience Research Centre, 2018), designed to assess resilience in adults. It operates on the premise that resilience is built on contextually relevant resources like physical assets, relational supports, and services, and that resilience is dynamic over time. The ARM-28 targets three key areas: relational, individual, and contextual resilience processes. It aims to identify the socio-ecological resilience resources available to adults exposed to environmental risks.

Clark et al. (2022) used the ARM-28 to explore resilience in victims of conflict-related sexual violence from three different countries: Bosnia and Herzegovina, Colombia, and Uganda. The study posited that the ARM-28 is a 28-item scale

focusing on measuring protective resources across individual, relational, and contextual domains. Findings revealed that while there were common elements of resilience across these countries, significant differences also existed, reflective of each country's unique cultural and situational context. Therefore, the study concluded that a one-size-fits-all factor structure for the ARM-28 is inadequate for capturing the nuanced protective factors linked to each nation's specific circumstances.

The Academic Resilience Scale (ARS-30; Cassidy, 2016)

The ARS-30 is a specialised tool designed to measure resilience in academic settings, capturing more than just outcomes by emphasising the processes that underlie resilience. Created by Cassidy in 2016, this scale operates on a Likert scale ranging from 1, which signifies "likely," to 5, for "unlikely." It includes vignettes to simulate adverse academic situations, making it particularly relatable for students. The scale examines three primary factors: perseverance, reflective and adaptive help-seeking, and negative emotional responses. High scores in the first two factors coupled with low scores in the third factor indicate higher resilience.

In Cassidy's initial study, the ARS-30 was administered to a sample of 532 British undergraduate students. The study revealed acceptable levels of internal consistency with a Cronbach's alpha of 0.90 and accounted for a significant 42.4% variance in academic resilience scores. The study also segmented its sample into two groups to test both the original and an alternative version of the questionnaire, aiming to assess its discriminant validity.

However, the scale has a few limitations. The study had a notable gender imbalance, which might affect the generalisability of its findings. In addition, while the ARS-30 aims to capture the ability to 'bounce back' from academic setbacks, this particular aspect needs further empirical validation. Future research should aim to confirm these findings and examine the scale's applicability to a more diverse student population, particularly focusing on the underrepresented male demographic. Despite these limitations, the ARS-30 stands as an innovative tool for capturing the complexities of academic resilience.

Procedure and ethical aspects

The study obtained ethical clearance from Nelson Mandela University's Research Ethics Committee: Human (REC-H) under the approval reference number: H20-EDU-ERE-026. Following this approval, additional institutional permissions were acquired from the appropriate university managerial gatekeepers to facilitate research involving students. Recruitment and orientation of participants were conducted through digital channels; this included sending informational emails and hosting an online session to outline the study's objectives and protocols. Participation was entirely elective, and all individuals were informed that they could opt out at any stage of the study without offering a justification or incurring any penalties. To

guarantee confidentiality, each participant's responses were numerically coded to safeguard anonymity.

Data analysis

The study employed both descriptive (Fisher et al., 2009) and inferential statistical techniques (Allua & Thompson, 2009) to analyse the quantitative data collected. Descriptive statistics were computed based on the administered measuring instruments to provide a detailed overview. For inferential analysis, statistical tests were conducted to ascertain if significant relationships existed among variables such as perseverance, negative affect, reflective help-seeking, academic resilience, personal resilience, relational resilience, resilience, and distress scores generated by the participants.

Results

The quantitative data collected in this study offered several crucial insights into the academic resilience of the final-year BET students at Nelson Mandela University. In this phase, 66 students from industrial, civil, electrical, marine, and mechanical engineering courses participated by completing a series of the above-mentioned standardised psychometric measurement tools. The study participants demonstrated high levels of resilience, a finding that was to be expected considering their stage of study (final-year) and the perseverance required to complete their BET courses. These results offer a quantitative perspective on academic resilience among South African engineering students, highlighting the multifaceted nature of resilience and the myriad factors that contribute to it.

Differences were noted between branches of engineering, but across the board, those students who could self-identify their psychological distress symptoms and challenges proactively sought out resources such as orientation, peer support, and academic success strategy workshops provided by the University. Students entering university with higher scores in mathematics and physical sciences displayed greater academic resilience in their engineering studies, a promising indicator for academic admission processes.

Overall, our study reveals that the majority of the student sample demonstrated minimal symptoms related to mental health, with anxiety and mania being the only conditions where over 30% reported moderate or severe symptoms. Our sample generally reported high levels of personal, relational, and academic resilience, supported by strong family bonds and a sense of community.

With regards to risk, the DSM-5 CCSM-A and other scales employed in the study indicated a range of mental health experiences, from mild to severe, across domains

like depression, anxiety, and mania. Table 1 presents frequency distributions for the DSM-5 CCSM-A domains.

Table 1: *Frequency Distributions: DSM-5 CCSM-A Domain Categories (n = 59)*

	None/Slight		Mild/Moderate/Severe	
Depression	26	44%	33	56%
Anger	43	73%	16	27%
Mania	21	36%	38	64%
Anxiety	25	42%	34	58%
Somatic symptoms	44	75%	15	25%
Suicidal ideation	51	86%	8	14%
Psychosis	55	93%	4	7%
Sleep problems	41	69%	18	31%
Memory	47	80%	12	20%
Repetitive thoughts and behaviours	39	66%	20	34%
Dissociation	45	76%	14	24%
Personality functioning	38	64%	21	36%
Substance use	48	81%	11	19%

According to Table 1, the majority of the participants in the sample reported to have experienced none or slight distress in relation to all the domains, with the exception of depression, mania and anxiety.

Similarly, with regards to resilience, the resilience measures indicated a spread from low to very high levels. Table 2 presents the frequency distribution for the Adult and Academic Resilience scales.

According to Table 2, the majority of the participants in the sample reported to have experienced high to very high resilience with regards to Relational Resilience (88%), Personal Resilience (77%), Adult Resilience (85%), Perseverance (77%) and Reflection Help Seeking (85%). Most participants (95%) indicated to have experienced middle to high resilience in relation to Academic Resilience. The majority (58%) of the sample reported to have experienced very low to low resilience with regards to Negative Affect.

The volume of data gathered in this study is extensive, and for the sake of brevity and readability, only a summary of the descriptive and inferential statistics is provided next.

Table 2: *Frequency Distributions: Adult and Academic Resilience Scales*

	Very Low 0.00 to 19.99		Low 20.00 to 39.99		Middle 40.00 to 60.00		High 60.01 to 80.00		Very High 80.01 to 100.00		Total	
Personal Resilience:												
Relational resilience	2	4%	2	4%	2	4%	14	26%	33	62%	53	100%
Personal resilience	0	0%	3	6%	9	17%	18	34%	23	43%	53	100%
Adult resilience	0	0%	3	6%	5	9%	20	38%	25	47%	53	100%
Academic Resilience:												
Perseverance	0	0%	2	4%	9	19%	29	62%	7	15%	47	100%
Reflection help seeking	1	2%	1	2%	5	11%	18	38%	22	47%	47	100%
Negative affect	12	26%	15	32%	14	30%	6	13%	0	0%	47	100%
Academic resilience	0	0%	2	4%	10	21%	35	74%	0	0%	47	100%

Summary of descriptive statistics

The sample encompassed 66 BET students in their final year (average age 23.3 years, SD = 3.02). All participants provided demographic information and completed the K10 (Kessler et al., 2002). Subsequently, a subset of 59 students from the final year completed the DSM Self-Rated Level 1 CCSM-A (American Psychiatric Association, APA, 2013); 53 engaged with the ARM-R (Resilience Research Centre, 2018); and 47 responded to the ARS-30 (Cassidy, 2016).

Ninety-two per cent of the participants identified as citizens of South Africa, with the remaining 8% being international students. In terms of racial composition, 61% identified as 'black', 24% as 'white', and 15% as 'coloured'. The predominant home language spoken among the respondents was isiXhosa, represented by 43%, with Afrikaans and English both at 29%. Only a single participant disclosed living with a diagnosable mental disorder when completing the survey. No participants indicated living with a disability.

The majority of the sample consisted of students studying mechanical engineering (35%), with civil engineering students comprising 32%, electrical engineering students making up 26%, industrial engineering at 6%, and marine engineering at 2%. A significant majority, 65%, stated they participated in the How2@Mandela orientation programme (aimed at first-year transition) at the onset of their academic pursuits. However, less than half, 44%, reported attending sessions for subject-specific tutoring (offered for high-risk modules such as mathematics, physics, and

engineering drawings), and fewer, only 24%, mentioned their attendance at the academic success strategy workshops (focused on time management, study skills, etc.) during their academic years.

The majority of participants specified that Nelson Mandela University was their preferred tertiary institution, with 71% stating it was their first choice. Additionally, 86% were accepted into their primary choice of academic programme, and 82% mentioned they didn't have to undertake an admission test. Such tests are necessitated when prospective students don't fulfill the direct admission prerequisites for a specific academic programme. South African universities employ an Admission Point Score (APS) system, whereby each subject undertaken in the final high school year is allocated an APS. The total APS acquired determines eligibility for different courses or degrees based on their respective requirements. The predominant score range for mathematics was 70-79%, as reported by 38% of the participants, and for physical science, 33% of the participants achieved scores within the 60-69% range during their Grade 12 year (the concluding year of South African secondary education).

Fifty per cent of the participants were first-generation university students, signifying they were the inaugural members of their families to attend university. Concerning financial aid, a substantial number of students, 41%, received support from the National Student Financial Aid Scheme (NSFAS) provided by the South African government. An equivalent proportion, 17%, indicated receiving financial support either from parents or family or through a bursary from a public organization, while a smaller segment, 11%, stated they were self-funded. Additionally, 21% of the participants benefitted from the School of Engineering's Meal-A-Day project, a programme aimed at offering one meal per day to students in financial need.

Summary of inferential statistics

Turning to our inferential statistics, we used the Chi-square (Chi^2) tests of independence to explore the relationships between categorical variables. Among these, we found nuanced differences in mental health symptoms and resilience markers across language, gender, and age groups.

The ability to study and learn in their home language seemed to contribute positively to students' academic resilience and their ultimate success in course completion. For instance, English-speaking students reported higher levels of personal resilience compared to their Afrikaans and Xhosa counterparts. Table 3 presents the relationship between home language and Personal Resilience.

Table 3 indicates that a significantly larger proportion of Xhosa-speaking students (42%) experience lower (<=60) levels of Personal Resilience compared to English and Afrikaans-speaking students (8%).

Table 3: *Contingency Table – Home Language and Personal Resilience*

	Personal Resilience					
Home Language	<=60		>60		Total	
Afrikaans or English	2	8%	24	92%	26	100%
Xhosa	5	42%	7	58%	12	100%
Total	7	18%	31	82%	38	100%

Chi^2 (d.f. = 1, n = 38) = 4.70; p = .030; V = 0.35 Medium. Constant 4 added to observed frequencies to meet the requirements for minimum expected frequencies.

Female students, outnumbered in the engineering field, tended to somatise psychological distress more than their male counterparts. Table 4 presents statistics for the relationship between gender and somatic symptoms.

Table 4: *Contingency Table – Gender and Somatic Symptoms*

	Somatic Symptoms					
Gender	None/Slight		Mild/Moderate/ Severe		Total	
Male	37	84%	7	16%	44	100%
Female	7	50%	7	50%	14	100%
Total	44	76%	14	24%	58	100%

Chi^2 (d.f. = 1, n = 58) = 6.74; p = .009; V = 0.34 Medium

Table 4 indicates that a significantly larger proportion (50%) of female students experience mild/moderate/severe problems related to somatic symptoms compared to the male students (16%). This is consistent with the widespread phenomenon of women's tendency to somatise problems (Delisle et al., 2012).

Younger students (20-24 age group) showed higher resilience levels than those aged 25 and above. Table 5 presents statistics for the relationship between age category and Personal Resilience.

Table 5: *Contingency Table – Age Category and Personal Resilience*

	Personal Resilience					
Age Category	<=60		>60		Total	
20-24	7	17%	35	83%	42	100%
25+	5	45%	6	55%	11	100%
Total	12	23%	41	77%	53	100%

Chi^2 (d.f. = 1, n = 53) = 4.12; p = .042; V = 0.28 Small

Table 5 reveals that a significantly larger proportion of students in the 25+ age category (45%) experience lower (<=60) levels of Personal Resilience compared to students in the 20-24 age category (17%). This discrepancy highlights the need for targeted support and interventions for older students who seem to be struggling more with Personal Resilience. Table 6 presents statistics for the relationship between age category and Adult Resilience.

Table 6: *Contingency Table – Age Category and Adult Resilience*

	Adult Resilience					
Age Category	<=60		>60		Total	
20-24	4	10%	38	90%	42	100%
25+	4	36%	7	64%	11	100%
Total	8	15%	45	85%	53	100%

Chi^2 (d.f. = 1, n = 53) = 4.90; p = .027; V = 0.30 Medium

Table 6 illuminates that a significantly larger proportion of students in the 25+ age category (36%) experience lower (<=60) levels of Adult Resilience compared to their younger counterparts in the 20-24 age category (10%). This divergence underscores the heightened struggles faced by the older students in building Adult Resilience.

The divergences observed in Tables 5 and 6 underscore the pronounced struggles of students in the 25+ age category, both with Personal and Adult Resilience. These results highlight the imperative for exploring and implementing targeted interventions and supportive measures specifically tailored to address the resilience needs of this older demographic, thereby aiming to mitigate the identified resilience gaps.

Furthermore, attending orientation programmes and academic success workshops appeared to positively influence resilience and reduce symptoms of depression and anger as well as sleep problems. Tables 7 to 9 present statistics for the relationship between whether the students attended any academic success strategy workshops and DSM-5 CCSM-A variables, specifically depression, anger, and sleep problems.

Table 7: *Contingency Table – Academic Success Strategy Workshop Attendance and Depression*

	Depression					
Attend any Academic Success Strategy Workshops	None/Slight		Mild/Moderate/ Severe		Total	
Yes	10	67%	5	33%	15	100%
No	16	36%	28	64%	44	100%
Total	26	44%	33	56%	59	100%

Chi^2 (d.f. = 1, n = 59) = 4.17; p = .041; V = 0.27 Small

Table 7 indicates that a significantly larger proportion of students who did not attend any Academic Success Strategy Workshops experienced mild/moderate/severe depression (64%) compared to those who attended such workshops (33%).

Table 8: *Contingency Table – Academic Success Strategy Workshop Attendance and Anger*

	Anger					
Attend any Academic Success Strategy Workshops	None/Slight		Mild/Moderate/ Severe		Total	
Yes	14	93%	1	7%	15	100%
No	29	66%	15	34%	44	100%
Total	43	73%	16	27%	59	100%

Chi^2 (d.f. = 1, n = 59) = 4.26; p = .039; V = 0.27 Small

Table 8 reveals that a significantly larger proportion of students who did not attend any Academic Success Strategy Workshops experienced more than slight anger (34%) compared to those who attended such workshops (7%).

Table 9: *Contingency Table – Academic Success Strategy Workshop Attendance and Sleep Problems*

	Sleep Problems					
Attend any Academic Success Strategy Workshops	None/Slight		Mild/Moderate/ Severe		Total	
Yes	14	93%	1	7%	15	100%
No	27	61%	17	39%	44	100%
Total	41	69%	18	31%	59	100%

Chi^2 (d.f. = 1, n = 59) = 5.39; p = .020; V = 0.30 Medium

Table 9 unveils that a significantly larger proportion of students who did not attend any Academic Success Strategy Workshops experienced more than slight sleep problems (39%) compared to those who attended such workshops (7%).

The insights derived from Tables 7, 8, and 9 collectively illustrate the substantial implications of non-attendance at Academic Success Strategy Workshops on students' well-being. The data underscores a discernible correlation between non-attendance and elevated levels of depression, heightened expressions of anger, and increased prevalence of sleep problems among students. These interlinked results emphasise the critical need for reinforced strategies, perhaps in the form of enhanced encouragement or mandates for workshop attendance, aimed at alleviating the myriad of adverse effects observed. Further exploration is warranted to ascertain the optimal approaches and interventions necessary to mitigate these prevalent issues and foster an environment conducive to both academic success and holistic well-being of the students.

Relationships between the scales

Table 10 presents the Pearson correlation coefficients that were used to recognise and analyse the strength and direction of the relationships between the scales. Correlations with absolute value greater than or equal to 0.30 are deemed significant according to the recognised guidelines and are in bold in Table 10.

Table 10: *Pearson Product Moment Correlations for the Scales*

		Academic Resilience				Adult Resilience			Kessler
		Perseverance	Negative affect	Reflection	Academic resilience	Personal resilience	Relational resilience	Adult resilience	Psychological distress
Academic Resilience	Perseverance	-	-.225	.749	.845	.096	.139	.128	-.341
	Negative affect	-.225	-	-.229	.133	-.299	-.071	-.218	.481
	Reflection	.749	-.229	-	.878	.118	.233	.188	-.265
	Academic resilience	.845	.133	.878	-	.017	.198	.109	-.154
Adult Resilience	Personal resilience	.096	-.299	.118	.017	-	.632	.925	-.472
	Relational resilience	.139	-.071	.233	.198	.632	-	.879	-.295
	Adult resilience	.128	-.218	.188	.109	.925	.879	-	-.435
Kessler	Psychological distress	-.341	.481	-.265	-.154	-.472	-.295	-.435	-

The results in Table 10 summarized according to the scales are (values in parentheses are correlations):

Academic Resilience

- Perseverance:
  - Positively correlated with Reflection (.749) and Academic Resilience (.845).
  - Negatively correlated with Kessler Psychological Distress (-.341).
- Negative affect:
  - Positively correlated with Kessler Psychological Distress (-.481).
- Reflection:
  - Positively correlated with Perseverance (.749) and Academic resilience (.878).

- Academic resilience:
  - Positively correlated with Academic Resilience (.845) and Reflection (.878).

Adult Resilience

- Personal resilience:
  - Negatively correlated with Kessler Psychological Distress scale (-.472).
- Adult resilience:
  - Negatively correlated with Kessler Psychological Distress scale (-.435).

Kessler Psychological Distress

- Positively correlated with Negative Affect (.481).
- Negatively correlated with Perseverance (-.341) and Personal Resilience (-.472).

As observed in Table 10, the data elucidates the paramount importance of bolstering both perseverance and personal resilience as crucial strategies for mitigating distress. Interestingly, both the symptoms and domains from the DSM-5 exhibit a positive correlation with negative affect and the Kessler Distress Scale, aligning with conventional expectations. However, they do not correlate with perseverance or reflection under the academic resilience measure. This absence of correlation is somewhat surprising, particularly considering the observed negative correlation with adult resilience, indicating a potential differentiation in the roles and impacts of academic and adult resilience in relation to distress. These intricacies point toward a nuanced and multifaceted interplay between different aspects of resilience and mental health, setting the stage for a more comprehensive understanding of students' mental states and resilience capacities. Overall, the results offer a nuanced view of the students' mental health and resilience statuses, enriched by statistical testing, as seen above, to highlight relationships between variables. The insights gleaned from this examination serve as a precursor to the concluding reflections, aiming to synthesise the results into coherent insights and implications.

Conclusion

The quantitative data from this study revealed generally strong levels of academic resilience among the final-year BET students. The measures of risk and resilience, as assessed by the measurement items, revealed statistically significant levels of perseverance and resilience in the face of academic challenges. The diversity of the results suggests that categorical variables do indeed have an impact, affecting the likelihood of a student belonging to a particular group for a given measure.

The qualitative findings, particularly from the lecturer and support staff sub-samples which have been explored extensively in prior published work (Mapaling

et al., 2021, Mapaling et al., 2022, Mapaling et al., 2024), depict a contrasting, more challenging picture of the students' lives. During the interviews with the different sample groups, it was observed that students, answering based on their experiences, were likely more engaged, while the staff, overwhelmed by numerous responsibilities during the COVID-19 pandemic, were more observational in their responses. Another explanation for the discrepancy observed is the potential inclination of individuals towards impression management when responding to psychometric instruments (Riemer & Shavitt, 2011), leading to more favourable responses. This variance between the qualitative and quantitative findings underscores the complexities of academic resilience. This chapter emphasises the importance of quantitative research in revealing aspects of resilience that qualitative data might overlook and has significant implications for improving student support interventions in challenging academic environments like engineering.

In addition, according to lecturers (as part of the broader study) (Mapaling, 2023), there has been a change in the practical training received by students, with those enrolled in the diploma programme receiving a year of practical training in preparation for their future careers, unlike the current BET degree students. This brings forth the necessity for further research to refine interventions and to delve deeper into the under-researched areas related to students' perceptions of their university training in relation to their future careers.

Strengths and limitations of the study

The study is underpinned by several noteworthy strengths that lend it both depth and breadth. It features a comprehensive review of existing literature, incorporating global perspectives that span from South Africa to India and beyond. The inclusion of recent phenomena such as the impact of COVID-19 and online distance learning adds a layer of timeliness and relevance to the research. Furthermore, the focus on students' self-reported experiences provides invaluable qualitative insights, enriched by an awareness of cultural and linguistic differences.

While the study provides valuable insights, it also has certain limitations. The dependence on self-reported data could introduce subjective biases, potentially affecting the study's broader applicability. Additionally, the focus on engineering students may limit the relevance of the findings to other academic disciplines. The study mainly offers a snapshot of student perceptions, which could be influenced by other external variables not examined, such as prevailing economic or educational policies. Moreover, the research is confined to a relatively small geographic area and setting, specifically the Nelson Mandela University, which may not capture the diverse experiences and challenges faced by students in other parts of South Africa.

Furthermore, the study is not without its methodological limitations. For example, the use of the DSM-5 CCSM-A as a screener for mental health issues in

higher education introduces several gaps. The current study failed to collect clinical diagnostic data and did not compare the DSM-5 CCSM-A to more comprehensive psychopathology scales. Furthermore, the instrument has not been assessed according to recognised standards like the Standards for Educational and Psychological Testing and lacks normative data, calling into question its specificity and suitability for this particular setting. As for the K-10 scale, the lack of established cut-off scores and normative data for the specific populations in the study necessitates further research for its effective application. The study also utilized the ARM-R and ARS-30 instruments to measure resilience. These instruments, originating from Canada and Britain respectively, were administered without prior usage in a South African context (Laher & Cockcroft, 2013), although they have been found to be reliable in international contexts. Some of the items on the ARS-30 were reverse scored, adding another layer of complexity. Despite their international validity, questions remain about their applicability within South Africa, particularly considering the nation's unique cultural and linguistic landscape. Therefore, more research is warranted to validate these measures for local usage. Overall, these limitations related to measurement tools point to the need for further research to establish their validity and reliability in diverse academic settings.

Acknowledgements

We express our profound gratitude to Kirstie Eastwood and Dr Danie Venter for their meticulous assistance with the statistical analysis. A special acknowledgement to Dr Venter for his critical reading and insightful scrutiny of the statistics presented in this chapter, which immensely contributed to the precision and reliability of our results.

References

Allua, S., & Thompson, C. B. (2009). Inferential statistics. *Air Medical Journal, 28*(4), 168–171. https://doi.org/10.1016/j.amj.2009.04.013

Alva, N. (2018, March 31). 34% faculty shortage hits IITs across India. *The Times of India*. https://timesofindia.indiatimes.com/city/bengaluru/34-faculty-shortage-hits-iits-across-india/articleshow/63552686.cms

American Psychiatric Association (APA). (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Andrews, G., Henderson, S., & Hall, W. (2001). Prevalence, comorbidity, disability, and service utilisation: An overview of the Australian National Mental Health Survey. *British Journal of Psychiatry, 178*(2), 145–153.

Bantjes, J., Saal, W., Lochner, C., Roos, J., Auerbach, R. P., Mortier, P., Bruffaerts, R., Kessler, R. C., & Stein, D. J. (2020). Inequality and mental healthcare utilisation among first-year university students in South Africa. *International Journal of Mental Health Systems, 14*(5), 1–11. https://doi.org/10.1186/s13033-020-0339-y

Bengesai, A. V., & Pocock, J. (2021). Patterns of persistence among engineering students at a South African university: A decision tree analysis. *South African Journal of Science, 117*(3/4), 1–9. https://doi.org/10.17159/sajs.2021/7712

Bennett, D., Maynard, N., Kapoor, R., & Kaur, R. (2014). Engineering students' perceptions for engineers and engineering work. In *Proceedings of the Australasian association of engineering education conference 2014* (pp. 894–901). School of Engineering & Advanced Technology, Massey University.

Bravo, A. J., Villarosa-Hurlocker, M. C., & Pearson, M. R. (2018). College student mental health: An evaluation of the DSM-5 Self-rated Level 1 Cross-cutting Symptom Measure. *Psychological Assessments, 30*(10), 1382–1389.

Campbell, A. L., Direito, I., & Mokhithi, M. (2021). Developing growth mindsets in engineering students: A systematic literature review of interventions. *European Journal of Engineering Education, 46*(4), 503–527.

Carnell, P. H., Schwab, M. C., Sochacka, N. W., & Hunsu, N. J. (2020, October). Performance and perception: A preliminary examination of factors that may motivate students to bounce back. In *2020 IEEE Frontiers in Education Conference* (FIE) (pp. 1–4).

Cassidy, S. (2016). The Academic Resilience Scale (ARS-30): A new multidimensional construct measure. *Frontiers in Psychology, 7*(1787), 1–11. https://doi.org/10.3389/fpsyg.2016.01787

Chiara, A., Lee, T. J., & Lee, M. S. (2021). Psychological well-being of foreign university students during the COVID-19 pandemic: A cross-sectional study in South Korea using the Kessler Psychological Distress Scale (K10). *Journal of Global Health Science, 3*(2), e15. https://doi.org/10.35500/jghs.2021.3.e15

Clark, J. N., Jefferies, P., Foley, S., & Ungar, M. (2022). Measuring resilience in the context of conflict-related sexual violence: A novel application of the Adult Resilience Measure (ARM). *Journal of Interpersonal Violence, 37*(19–20), NP17570–NP17615. https://doi.org/10.1177/08862605211028323

Cross, K. J., & Jensen, K. J. (2018, January 24–27). *Work in progress: Understanding student perceptions of stress as part of engineering culture* [Conference paper]. American Society of Engineering Education annual conference and exposition, Salt Lake City, UT, United States.

Danta, N. (2023, January 12). *Challenges engineering students face today in the education system* [Post]. LinkedIn. https://www.linkedin.com/pulse/challenges-engineering-students-face-today-education-system-danta/

Delisle, V. C., Beck, A. T., Dobson, K. S., Dozois, D. J. A., & Thombs, B. D. (2012). Revisiting gender differences in somatic symptoms of depression: Much ado about nothing? *PLoS ONE, 7*(2), e32490.

Demuyakor, J. (2020). Coronavirus (COVID-19) and online learning in higher institutions of education: A survey of the perceptions of Ghanaian international students in China. *Online Journal of Communication and Media Technologies, 10*(3), e202018.

Downs, M. F., & Eisenberg, D. (2012). Help seeking and treatment use among suicidal college students. *Journal of American College Health, 60*(2), 104–114.

Feinberg, I., O'Connor, M. H., Owen-Smith, A., & Dube, S. R. (2021). Public health crisis in the refugee community: Little change in social determinants of health preserve health disparities. *Health Education Research, 36*(2), 170–177.

Fisher, M. J., & Marshall, A. P. (2009). Understanding descriptive statistics. *Australian Critical Care, 22*(2), 93–97.

Gero, A., Stav, Y., & Yamin, N. (2017). Use of real-world examples in engineering education: The case of the course electric circuit theory. *World Transactions on Engineering and Technology Education, 15*(2), 120–125.

Gerwel Proches, C. N., Chelin, N., & Rouvrais, S. (2018). Think first job! Preferences and expectations of engineering students in a French 'Grande Ecole'. *European Journal of Engineering Education, 43*(2), 309–325.

Goodier, R. (2019, December 19). Engineers are not ending poverty. Time for a change? *Engineering for Change*. https://www.engineeringforchange.org/news/engineers-not-ending-poverty-time-change/

Hanson, M. (2021, December 12). Student loan debt by race. *Education Data Initiative*. https://educationdata.org/student-loan-debt-by-race

Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S. L., Walters, E. E., & Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine, 32*(6), 959–976. https://doi.org/10.1017/s0033291702006074

Khan, M. A., Nabi, M. K., Khojah, M., & Tahir, M. (2020). Students' perception towards e-learning during COVID-19 pandemic in India: An empirical study. *Sustainability, 13*(1), 57.

Laher, S., & Cockcroft, K. (2013). Current and future trends in psychological assessment in South Africa: Challenges and opportunities. In S. Laher & K. Cockcroft (Eds.), *Psychological assessment in South Africa: Research and applications* (pp. 535–552). Wits University Press.

Leibbrandt, M., Woolard, I., McEwen, H., & Koep, C. (2010). *Employment and inequality outcomes in South Africa*. Southern Africa Labour and Development Research Unit and School of Economics, University of Cape Town.

Liebenberg, L., & Moore, J. C. (2018). A social ecological measure of resilience for adults: The RRC-ARM. *Social Indicators Research, 136*(1), 1–19. https://doi.org/10.1007/s11205-016-1523-y

Macgeorge, E. L., Samter, W., & Gillihan, S. J. (2005). Academic stress, supportive communication, and health. *Communication Education, 54*(4), 365–372.

Mapaling, C. (2023). *Academic resilience of engineering students: A case study* [Unpublished doctoral thesis]. Nelson Mandela University. https://vital.seals.ac.za/vital/access/manager/Repository/vital:67337?site_name=GlobalView&f0=sm_mimeType%3A"application%2Fpdf"

Mapaling, C., du Plooy, B., & Webb, P. (2024). Diverse perceptions among engineering students and staff of the enablers and constraints of academic resilience. *South African Journal of Higher Education, 38*(4), 171–189. https://doi.org/10.20853/38-4-5764.

Mapaling, C., Webb, P., & du Plooy, B. (2021). "Everyone plays a key role": Students, lecturers and support staff in South Africa talk about the academic resilience of engineering students. In *Proceedings of the 14th annual international conference of education, research and innovation* (pp. 7201–7207). https://doi.org/10.21125/iceri.2021.1615

Mapaling, C., Webb, P., & du Plooy, B. (2022). "I would help the lecturer with marking": Entrepreneurial education insights on academic resilience from the perspectives of engineering students in South Africa. In J. Halberstadt, J. Greyling, A. A. de Bronstein & S. Bisset (Eds.), *Transforming entrepreneurship education: Interdisciplinary insights on innovative methods and formats* (pp. 177–196). Springer Nature. https://link.springer.com/chapter/10.1007/978-3-031-11578-3_10

Mathew, V. N., & Chung, E. (2020). University students' perspectives on open and distance learning (ODL) implementation amidst COVID-19. *Asian Journal of University Education, 16*(4), 152–160.

Peled, Y. (2017). Language and the limits of justice. *Journal of Multilingual and Multicultural Development, 38*(7), 645–657.

Qamar, K., Kiani, M. R., Ayyub, A., Khan, A. A., & Osama, M. (2014). Higher stress scores for female medical students measured by the Kessler Psychological Distress Scale (K10) in Pakistan. *Journal of Educational Evaluation for Health Professions, 11*, 27. https://doi.org/10.3352/jeehp.2014.11.27

Resilience Research Centre. (2018). *CYRM and ARM user manual*. Resilience Research Centre. https://resilienceresearch.org/home-cyrm/

Riemer, H., & Shavitt, S. (2011). Impression management in survey responding: Easier for collectivists or individualists? *Journal of Consumer Psychology: The Official Journal of the Society for Consumer Psychology, 21*(2), 157–168. https://doi.org/10.1016/j.jcps.2010.10.001

Saidalvi, A., Noorezam, M., Zakaria, N., Sa'adan, N., Wan, W. F. W., Fakhruddin, N. N. R., & Rahman, S. A. S. A. (2021). Diploma engineering students' perceptions of online distance learning. *International Journal of Recent Technology and Engineering, 10*(2), 119–128.

Sim, S. P. L., Sim, H. P. K., & Quah, C. S. (2021). Online learning: A post COVID-19 alternative pedagogy for university students. *Asian Journal of University Education, 16*(4), 137–151.

Song, L., Singleton, E. S., Hill, J. R., & Koh, M. H. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *The Internet and Higher Education, 7*(1), 59–70.

Staff Writer. (2019, July 10). Why South African engineers are leaving the country – despite huge demand and R1 million salaries. *Business Tech*. https://businesstech.co.za/news/business/328447/why-south-african-engineers-are-leaving-the-country-despite-huge-demand-and-r1-million-salaries/

Torpey, E. (2018, February). Engineers: Employment, pay, and outlook. *Bureau of Labor Statistics*. https://www.bls.gov/careeroutlook/2018/article/engineers.htm

Wang, H. (2014). Learner autonomy based on constructivism learning theory. *International Journal of Cognitive and Language Sciences, 8*(5), 1552–1554.

Willingham, D. T. (2021). *Why don't students like school? A cognitive scientist answers questions about how the mind works and what it means for the classroom* (2nd ed.). Jossey-Bass.

Yeoh, A. (2020, April 27). MCO: As lessons move online, local teachers and students struggle with uneven internet access. *The Star.* https://www.thestar.com.my/tech/tech-news/2020/04/27/mco-as-lessons-move-online-local-teachers-and-students-struggle-with-uneven-internet-access

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage.