
Investigating the Efficacy of the New Bachelor of Engineering Technology Degree in the Mechanical Engineering Department at Durban University of Technology

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Abstract: In 2018, the Department of Mechanical Engineering at the Durban University of Technology (DUT) introduced a Bachelor of Engineering Technology (BET) degree, alongside Master's (MEng) and Doctorate (DEng) degrees. For strategic reasons, the department, when aligning its programs with the Higher Education Qualifications Sub-Framework (HEQSF), replaced the National Diploma with the BET. This paper evaluates the academic success of Mechanical Engineering students in the BET programme and assesses its overall efficacy. Success is primarily measured through pass rates and throughput, as detailed in the individual investigations. Data was sourced from the institution's management information system (ITS) and analysed using a pragmatic, descriptive approach with quantitative methods across five investigations. Findings indicate that the programme's structure is generally effective, entrance requirements are appropriate, and specific modules, identified as bottlenecks, require targeted interventions to improve suboptimal success rates. These investigations have enhanced understanding of the programme, potentially guiding the Department in making informed decisions and implementing interventions to boost student success.

Keywords: efficacy; mechanical engineering; curriculum; student success

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Introduction

The Durban University of Technology (DUT) introduced the Bachelor of Engineering Technology (BET) degree to replace the National Diploma (ND) and Bachelor of Technology (BTech) programmes previously offered. This transition was driven by the Higher Education Qualifications Sub-Framework (HEQSF) requirements, which aims to establish a nationally coordinated higher education system, fostering course harmonisation and facilitating student mobility across programmes and institutions. Additionally, the BET degree serves as the academic requirement for registration with the Engineering Council of South Africa (ECSA) as a professional engineering technologist. This paper examines the success of Mechanical Engineering students enrolled in the BET programme and evaluates its overall efficacy. The investigation utilises readily available data from the University's management information system (ITS). The study comprises five longitudinal investigations, focusing on the following areas: success

rates of the BET programme; the suitability of entrance requirements by comparing NSC results with first-year BET outcomes; the impact of Graduate Attributes (GAs); the influence of “back-to-back” modules on student progression; and a comparison of success rates between the BET and ND programmes.

In developing new academic programs, universities must meet the requirements of various stakeholders and statutory bodies to ensure compliance, quality, and relevance. ECSA requires the program to align with professional accreditation standards, ensuring graduates meet specific outcomes. The Department of Higher Education and Training (DHET) assesses the program’s alignment with the institution’s Program Qualification Mix (PQM) and national priorities. The Council on Higher Education (CHE) ensures the program adheres to quality assurance standards, aligns with qualification frameworks, and maintains public confidence in higher education. Lastly, the South African Qualifications Authority (SAQA) verifies that the program meets the criteria for registration on the National Qualifications Framework (NQF), contributing to its national recognition and legitimacy. The three main categories of professional registration administered by ECSA are professional engineers, professional engineering technologists, and professional engineering technicians. The category of registration is primarily dependent on the academic qualifications of the applicants. In order to align with the HEQSF, ECSA developed a suite of qualification standards, providing the academic requirements for registration in the various categories (Engineering Council of South Africa 2020). Before adopting the HEQSF-aligned programmes, DUT offered the National Diploma (ND) and the bachelor’s degree in technology (BTech), which were followed by the master’s in technology (MTech) and Doctorate in Technology (DTech). After consulting stakeholders, the Faculty of Engineering and the Built Environment introduced a qualification pathway comprising the Bachelor of Engineering Technology (BET), BET Honours (BET Hons), Master of Engineering (MEng), and Doctor of Engineering (DEng). Launched in 2018, the BET equips graduates to meet the academic requirements for registration with ECSA as professional engineering technologists.

ECSA defines Graduate Attributes (GAs) as internationally benchmarked outcomes outlining the competencies graduates must possess to register as engineering professionals. These attributes ensure that graduates are equipped with the knowledge, skills, and ethical grounding necessary for the engineering profession and align with global standards for engineering education and professional practice. The BET programme incorporates 10 GAs, which encompass areas such as knowledge application, problem-solving, design, and professional responsibility. Universities offering engineering programmes incorporate GAs into their curricula to meet ECSA’s standards for accreditation. These attributes are developed, assessed, and documented throughout the programme, often with a focus on exit-level modules. At DUT, measures were implemented to ensure consistency in GA assessment. Only modules directly offered by the Mechanical Engineering Department are utilised for GA assessments, ensuring that the process is managed within the department’s expertise. Furthermore, passing the GA assessment is a mandatory requirement for passing the module. This policy prevents the inconsistency of a student passing a module but being unable to graduate due to unfulfilled GAs, thereby aligning academic progression with professional accreditation standards. The BET is a three-year programme containing 36 modules. The programme is semesterised, with each module being offered only once per year. The exceptions were Strengths of Materials I and Mechanics of Machines I. These two modules, initially offered in the second semester, have shown poor success rates since the programmes introduction. As of 2020, to address this, they were offered in both semesters, or “back-to-back”. By offering these modules twice a year, students who fail them could repeat them the following semester, rather than waiting an entire year. This approach could potentially improve throughput by minimising delays in academic progression and increasing the likelihood of timely graduation.

The National Senior Certificate (NSC) serves as the primary school-leaving qualification in South Africa and is classified as a South African Qualifications Authority (SAQA) Level 4 qualification. It plays a critical role in determining eligibility for higher education programmes (South African Qualifications Authority 2013). For the Bachelor of Engineering Technology (BET) programme, NSC results, particularly in Mathematics and Physical Sciences, are key entrance requirements. With the BET offered since 2018, it is appropriate to now evaluate its efficacy by reviewing success rates, bottleneck modules, entrance criteria, and alignment with objectives. These assessments will guide curriculum improvements and ensure continued relevance.

Literature review

The shortage of engineering skills in South Africa is recognised as a critical national concern (National Planning Commission, 2013). Despite a population exceeding 50 million, South Africa produces only a few thousand engineering graduates annually (Grayson et al., 2014). The National Development Plan (NDP) has highlighted

engineering as a scarce skill, essential for economic growth and infrastructure development. Persistently low engineering pass rates exacerbate the skills gap, raising concerns about whether the current higher education system is adequately preparing students for the workforce. Addressing this challenge requires data-driven decision-making, whereby institutional pass rates inform programme reforms, and benchmarking ensures that higher education institutions (HEIs) align with national skills development goals. Higher education in South Africa faces significant challenges, particularly as students transition from high school to university. The workload and pace of university courses are far more demanding than those encountered in high school, and many students are unprepared for this shift. As a result, many students struggle (Grayson et al., 2014). This issue is particularly pronounced in engineering and technical programs, where throughput rates (the rate at which a student cohort successfully completes a qualification within the expected timeframe) are notably low. Just over half of first-year engineering students complete their programs (Winberg et al., 2014). The Department of Higher Education and Training (DHET) reports similar issues, noting high dropout rates and poor graduation rates in engineering and science programmes, especially within the three-year diploma and degree programmes (DHET, 2020).

Nationally, only 25 percent of the 2005 cohort who registered for a Bachelor of Engineering (BEng) completed it within the allotted four years. A further 19 percent did so within five years, and a total of 55 percent had graduated after six years, according to data analysis by the Council on Higher Education (CHE) (Grayson et al., 2014). While students' lack of academic preparedness places considerable pressure on HEIs, this issue reflects broader systemic shortcomings that necessitate greater support throughout the education system. When designing new curricula, it is essential to take students' levels of preparedness into account to better align academic programmes with their needs and, ultimately, improve success rates within HEIs. Higher education institutions in South Africa operate within a structured policy framework intended to enhance student success rates. HEIs were mandated by the CHE and DHET to implement the new Higher Education Qualifications Sub-Framework (HEQSF) by 2020 (Kapp, 2019). The HEQSF Act No. 67 of 2007 (DHET 2008) established a unified qualifications framework across all HEIs, aiming to create a nationally coordinated system. This initiative sought to harmonise courses and allow for greater student mobility between programmes and institutions. However, despite these reforms, engineering education continues to experience low throughput and success rates, particularly within universities of technology. Structural and pedagogical adjustments, including curriculum redesign and enhanced student support initiatives, are necessary to bridge the gap between policy intentions and actual academic outcomes.

Pass rates are widely used as a measure of institutional effectiveness and academic programme success (Faudree et al. 2024; York et al., 2015). In South Africa, DHET has set a national higher education success rate target of 80 percent (DHET, 2013). However, this benchmark appears unrealistic for engineering courses, where non-completion rates range from 50 to 65 percent for four-year degrees (Pocock, 2012). First-year attrition rates in engineering programmes vary between 15–35 percent, making student retention an ongoing challenge. South African engineering degree completion rates, at 27–40 percent, fall significantly below the DHET benchmarks (Graham 2016). Engineering diploma programmes at universities of technology perform even worse, reflecting the additional challenges faced by students pursuing applied technical qualifications. While pass rates provide a valuable snapshot of student performance, they do not account for the broader structural and systemic factors affecting retention and completion. Institutional effectiveness (IE) research provides a robust framework for evaluating academic programmes by leveraging quantitative data to assess performance and drive continuous improvement. This approach emphasises aligning institutional goals with its mission through strategic planning that engages stakeholders to identify priorities and growth pathways (Cameron, 1985). Regular assessment of goals and measurable outcomes—such as student success, retention, and progression—allows institutions to refine strategies, allocate resources effectively, and foster a data-driven environment (Ewell, 2009; Midgough, 2011). Scholars like Volkwein (2010) advocate for a pragmatic descriptive approach, balancing analysis with actionable insights to address bottlenecks and optimise performance, making it particularly effective for programme evaluation.

Models like Welsh and Metcalf's (2003) Inputs-Processes-Outcomes framework guide programme assessments by providing actionable insights. Towne and Shavelson (2002) highlight the importance of feedback loops, which connect outcomes to inputs and processes, enabling continuous refinement and improvement. Similarly, Gokarna et al. (2022) emphasise benchmarking outcomes against national priorities to align strategies with broader objectives. The flexibility of these frameworks supports the examination of institutional data—such as pass rates, throughput, and retention statistics—prioritising actionable insights and practical applications (Creswell

& Poth, 2016; Kaushik & Walsh, 2019). Descriptive analysis further supports higher education by monitoring student performance and benchmarking it against national targets (Titus, 2021). Tinto's (2012) Model of Student Retention underscores institutional commitment to student success, stressing the significance of academic and social integration in improving persistence and completion rates. Similarly, Biggs et al. (2022) emphasise constructive alignment, where assessment practices are directly linked to student learning outcomes, validating pass rates as a critical evaluative tool.

Methodology

This study applies an IE-based conceptual framework to assess the BET programme's efficacy at DUT from 2018 to 2021, focusing on student success metrics structured around Inputs, Processes, and Outcomes. Inputs include student preparedness (e.g., NSC results) and programme design, while Processes involve activities such as longitudinal tracking and statistical analysis (e.g., Pearson's correlation coefficient) to evaluate cohort and module performance over time. The act of tracking success is considered part of the Processes, as it involves methods and tools used to gather and interpret data. Outcomes, however, represent the measurable results derived from these tracking processes, such as success rates, progression trends, and comparisons with the National Diploma programme, which serve as indicators of the programme's efficacy. A feedback loop connects outcomes to inputs and processes, enabling refinements such as addressing bottleneck modules or adjusting entrance criteria to be proposed. This systematic approach provides actionable insights for enhancing the BET programme. To evaluate the programme and identify improvement areas, the study employs a pragmatic descriptive approach, focusing on data-driven analysis of student success metrics. Analysis of key performance indicators—such as success rates, module-specific outcomes, and cohort progression trends—is done using descriptive statistics. This aligns with institutional effectiveness principles, enabling evidence-based evaluations and identifying areas for targeted interventions.

A pragmatic descriptive approach is well-suited to the study's aim, leveraging institutional data from 2018 to 2021 to assess the BET programme's efficacy across cohorts, module sequences, entrance requirement variations, and comparisons with the National Diploma (ND) programme. The approach prioritises simplicity and utility, using success rate calculations, percentage point increases, and comparative analyses to pinpoint areas where student outcomes fall short of expectations, thus signalling opportunities for improvement. Longitudinal studies are employed to track cohort performance over time, evaluate the impact of back-to-back module offerings, and assess the appropriateness of entrance requirements. Where relevant, additional statistical methods, such as Pearson's correlation coefficient (PCC), are incorporated to quantify relationships, particularly between NSC performance and first-year results. This combination of pragmatism and descriptiveness ensures the study delivers practical findings, offering a solid basis for evaluating the programme's strengths and identifying specific domains—such as bottleneck modules or graduate attribute (GA) impacts—requiring further attention or refinement.

Success rate is defined as the proportion of students achieving a passing grade (including supplementary examinations) relative to the total number enrolled in the subject at the time of examination. Student success refers to the percentage of students within a specific category (e.g., disaggregated data bands or NSC score ranges) who pass a module, relative to the total in that category. Percentage point increases (pp) are calculated as the arithmetic difference between two percentages to assess changes in success rates over time or between programmes. The term "average" denotes the arithmetic mean (sum of values divided by the number of values) unless otherwise specified. The following investigations employed success rates as the primary measure unless otherwise noted:

- **Success Rate Analysis:** Examined success rates of cohorts from 2018 to 2021 to identify bottleneck modules (e.g., Strengths of Materials stream) and structural issues in the BET programme, benchmarked against a faculty-determined 70% threshold.
- **Back-to-Back Modules:** Assessed whether consecutive semester offerings of Strengths of Materials I and Mechanics of Machines I (starting in 2020) improved success rates and progression, analysing both overall and repeating student performance longitudinally.
- **National Diploma vs. BET Comparison:** Compared success rates of analogous modules common to the ND and BET programmes across multiple semesters, using percentage point differences to evaluate the impact of increased entrance requirements.

In contrast, the following investigations used alternative or supplementary methods:

- NSC Study: Analysed correlations between NSC performance (Maths, Physics, and English) and first-year BET module results (e.g., Mechanics I, Mathematics IA, IB), with student success disaggregated into NSC score bands. PCC was used to measure the strength and direction of linear associations, supported by normality assumptions (Mukaka 2012), with interpretation guidelines from Zhou et al. (2016): small (0.1–0.3), medium (0.3–0.5), large (0.5–1.0).
- GA Study: Examined the impact of failing graduate attribute (GA) requirements on module throughput and progression, comparing failure rates due to GA assessments versus overall module performance in 2020–2021.

Pearson’s correlation coefficient (PCC) was utilised in the NSC study to assess linear relationships between NSC results and first-year module performance, with results interpreted using the Zhou et al. (2016) guidelines shown in Table 1. Data from all investigations were compiled from institutional records, ensuring reliability, and analysed to highlight trends, differences, and areas for intervention.

Table 1: Guidelines for the Pearson’s coefficient correlation interpretation (Zhou et al., 2016).

Strength of Association	Coefficient, r	
	Positive	Negative
Small	0.1 to 0.3	–0.1 to –0.3
Medium	0.3 to 0.5	–0.3 to –0.5
Large	0.5 to 1.0	–0.5 to 1.0

Ethical approval for this study was obtained from the University’s ethics committee, and the research adhered to all institutional standards.

Data analysis and results

The term “average” refers to the sum of all values divided by the total number of values in the set and is used in this investigation unless stated otherwise.

Success rates

Table 2 provides the success rates for the BET programme. Given the DHET norm of 80 percent, as mentioned earlier, is inappropriate for engineering programmes, the Faculty of Engineering and the Built Environment determined that a benchmark of 70 percent to be more fitting. The data indicates that the success rates are generally above this benchmark, with only one instance slightly below (69 percent for 1st Year in 2018). This suggests that no major structural problems are evident in the programme.

Table 2: Average success rates for academic years.

	2018	2019	2020	2021	Average
1 st Year	69%	71%	83%	80%	76%
2 nd Year	NA	76%	78%	68%	74%
3 rd Year	NA	NA	87%	86%	86%

Success rates of individual modules were also analysed to identify bottleneck modules which may be hindering throughput. Strengths of Materials I (48 percent), Mechanics of Machines I (56 percent), Strengths of Materials II (59 percent), CAD (60 percent) and Strengths of Materials III (51 percent) had the worst success rates indicating the need for targeted for intervention, particularly within the Strengths of Materials stream.

First-year engineering modules vs. NSC results

This investigation examined the correlation between NSC Maths, NSC Physics, and NSC English Home Language (HL) and NSC English First Additional Language (FAL) and selected first-year Engineering modules. Additionally, it evaluated the appropriateness of the entrance requirements for the programme. The first-year modules Mechanics I, Mathematics I and Mathematics IB were selected, as previous studies indicated success in first year mathematics and mechanics modules correlate with success in the programme as a whole (Walker & Graham, 2013). It also assessed the appropriateness of entrance requirements, currently set at a minimum NSC Level 4 (50%) for English, Maths, and Physics, with a combined Maths and Physics score of 120%.

Table 3 shows small correlations (0.05–0.25) observed between NSC English (HL and FAL) and the selected modules. Similarly Table 4 shows, NSC Physics and Maths exhibited small correlations with Mechanics I (0.16–0.20), but medium correlations with Mathematics IA (0.39–0.49) and IB (0.37–0.41), per Zhou et al. (2016) guideline

Table 3: Correlation between NSC English HL, NSC English FAL, and 1st year modules.

	Mechanics I	Mathematics IA	Mathematics IB
English HL	0.12	0.24	0.25
English FAL	0.05	0.2	0.2

Table 4: Correlation between NSC Physics, NSC Mathematics and 1st year modules.

	Mechanics I	Mathematics IA	Mathematics IB
NSC Physics	0.2	0.39	0.37
NSC Mathematics	0.16	0.49	0.41

To evaluate entrance requirements, combined NSC Maths and Physics scores were compared against success rates in first-year modules for 461 students (2018–2021) as shown in Table 5.

Table 5: Combined NSC Maths and Physics scores vs first year module success

NSC M + P	Mechanics I	Strengths I	Maths 1A	Maths 1B	Thermo-fluids I	Cohort
<110	50%	0%	100%	100%	100%	0.4%
110–119	50%	50%	50%	50%	50%	0.4%
120–129	50%	48%	79%	69%	52%	29%
130–139	51%	40%	81%	73%	59%	31%
140–149	56%	49%	84%	74%	53%	20%
150–159	56%	46%	70%	66%	55%	11%
160–200	56%	64%	80%	82%	66%	8%

n = 461.

A small percentage of students (0.4 percent) were enrolled without meeting the minimum entrance requirement of a combined NSC Mathematics and Physics score of 120. These students gained access via alternative pathways, such as completing a higher certificate or diploma after their NSC. Their success in the BET programme is likely attributable to their further qualifications rather than their NSC results, and as such, they can be excluded from this analysis. The majority of students (80 percent of the cohort) scored between 120 and 149. Within this range, 31 percent of students scored between 130 and 139 for NSC Mathematics and Physics. The current entrance requirement of a combined score of 120 appears appropriate, as the average success rates for all modules exceed 50 percent, with the exception of Strengths I (48 percent). The consistently low success rates for Strengths I across the various NSC Mathematics and Physics groups—apart from the 160–200 group—indicate that the benchmark remains a reliable measure. Further analysis of NSC Mathematics scores, not shown in the table, revealed that students with scores between 50 percent and 59 percent performed poorly on average in the first-year modules. This suggests that raising the minimum NSC Mathematics requirement to 60 percent may be more appropriate. A similar pattern was observed for NSC Physics scores, indicating that the NSC Physics entrance requirement should likewise be set at 60 percent or higher.

The effect of GAs

Given that the BET programme was only implemented in 2018, the earliest cohort of third-year students was in 2020, limiting this preliminary investigation to the years 2020 and 2021. Data for these years was compiled for each assessed module, including the number of students enrolled, those who failed the module, those who failed the GA assessment, and those who failed the module solely due to failing the GA assessment. In 2020, seven students failed a GA assessment, but none failed the module purely because of it. In 2021, 16 students failed a GA assessment, with only one failing the module for that reason. Over the two years, 23 students failed GA assessments. Of these, 22 would have failed the module regardless of their GA performance, indicating that the introduction of GA assessments did not contribute significantly to module failure. Across the investigation period, 101 students were registered for this module, and the single instance of failure due to the GA assessment alone is an outlier, lacking statistical significance.

Back-to-back modules

The modules Strengths of Materials I and Mechanics of Machines I were identified as needing a back-to-back offering (i.e., available in both semesters), starting in 2020. Originally, these modules were only offered in the second semester (S2) of each academic year. After the implementation of this intervention, students who failed the module during S2 were able to retake it in the first semester (S1) of the following year.

The data presented in Tables 6 and 7 highlights the success rates for the two modules, detailing the number of students who passed in each semester and the performance of repeating students. When disaggregated, the success rates for S1 offerings are notably higher than those of S2 offerings. This suggests that the intervention—allowing students to retake these bottleneck modules in the following semester while the material is still relatively fresh—has been effective in enhancing academic performance and progression.

Table 6: Back-to-back module success rates for Mechanics I.

Year and semester	Number of students	Total passed	Overall success rate	Number of repeating students	Number of repeating students passed	Repeating student success rate
2018 S2	97	25	26%	-	-	-
2019 S2	159	109	69%	41	30	73%
2020 S1	22	18	82%	20	16	80%
2020 S2	129	76	59%	7	0	0%
2021 S1	17	14	82%	17	14	82%
2021 S2	131	88	67%	39	19	49%

Table 7: Back-to-back module success rates for Strengths I.

Year and semester	Number of students	Total passed	Overall Success Rate	Number of repeating students	Number of repeating students passed	Repeating student success rate
2018 S2	98	53	54%	-	-	-
2019 S2	134	30	22%	17	7	41%
2020 S1	57	43	75%	56	42	75%
2020 S2	153	98	64%	29	17	59%
2021 S1	18	13	72%	18	13	72%
2021 S2	134	60	45%	41	21	51%

Table 8 outlines the number of attempts made by students to successfully complete Mechanics of Machines I. As anticipated, the S1 offerings primarily consist of repeat students, which aligns with the intervention's intended purpose. According to departmental regulations, students must complete the BET within five years of registration, allowing them to fail no more than two academic years. However, it is notable that some students attempt this first-year module up to four times. This scenario makes it unfeasible for such students to complete the degree, as they would need to re-register multiple times to progress to subsequent modules, thereby exceeding the maximum allowable registrations. Additionally, Table 8 shows that the number of students enrolling for the S1 offering of the module is lower than expected, considering the number of failures recorded in the preceding S2 offering. This indicates that some students who fail the S2 offering either choose to wait a full year to retake the module during the subsequent S2 offering or drop out of the programme entirely. A similar trend is observed with Strengths of Materials I. The number of students registered for the S1 offering of this module is also significantly lower than expected. Furthermore, as with Mechanics of Machines I, several students were found to register for this module three or even four times. This pattern suggests that these students would be unable to complete the degree within the maximum allowable timeframe.

Table 8: Attempts at Mechanics I.

Semester	First Attempt	Second Attempt	Third Attempt	Fourth Attempt	Fifth Attempt	Sixth Attempt
2018 S2	97	N/A	N/A	N/A	N/A	N/A
2019 S2	118	41	N/A	N/A	N/A	N/A
2020 S1	2	17	3	N/A	N/A	N/A
2020 S2	122	4	3	0	N/A	N/A

(Continued)

Table 8: (Continued)

Semester	First Attempt	Second Attempt	Third Attempt	Fourth Attempt	Fifth Attempt	Sixth Attempt
2021 S1	0	10	6	1	0	N/A
2021 S2	92	36	1	2	0	0

Comparison of ND and BET modules

The entrance requirements for the new BET programme are higher than those of the previously offered ND programme. To assess whether the increased entrance requirements have influenced student success rates, the success rates of BET modules, deemed comparable to modules in the ND programme, were analysed. For the ND programme, data spanning eight semesters was utilised due to its availability. In contrast, only four years' worth of data was available for the BET programme, covering the years 2018–2021. Mechanics I in the first semester of the ND programme was considered analogous to Physics 1A and Physics 1B in the BET programme. Similarly, Maths I in first semester of the ND programme was compared to Engineering Mathematics 1A in the BET programme. The average student success rate for Mechanics I (ND) across eight semesters was 58 percent. Comparatively, the success rates for Physics 1A and Physics 1B (BET) across four semesters were 89 percent and 86 percent, reflecting increases of 31 percentage points (pp) and 28 pp, respectively. Furthermore, the average student success rate for Maths I (ND) was 64 percent, whilst Engineering Mathematics 1A (BET) achieved a success rate of 89 percent, representing a 25 pp increase.

A similar process was undertaken for modules across all four semesters of the ND and BET equivalents. The overall percentage point differences across each semester's modules are summarised as follows:

- First semester: A 53 pp increase for BET modules.
- Second semester: A 31 pp increase for BET modules.
- Third semester: A 5 pp decrease for BET modules.
- Fourth semester: A 66 pp increase for BET modules.

Overall, the data demonstrates that BET modules have significantly higher student success rates compared to ND modules. The findings suggest that the increased entrance requirements for the BET programme have played a pivotal role in improving student success rates.

Discussion

Three of the nine first-year modules fell below the student success rate benchmark, with Strengths I notably lower at 52 percent. Modules with success rates between 70 and 80 percent should be monitored to ensure these rates do not decline in future years, while targeted interventions should be implemented for modules with lower success rates. For Strengths I, immediate interventions, such as additional tutorials, are essential to improve student outcomes. For the second-year modules, eight out of twelve achieved an average student success rate of 70 percent or higher, exceeding the benchmark. However, the success rates for Computer-Aided Design (CAD) and Design II in 2021 were notably poor, especially when compared to their 2019 and 2020 success rates. The drop in 2021 may be attributed to the appointment of a part-time lecturer in that year. This issue has since been resolved with the appointment of a new full-time lecturer in 2022. CAD should be given additional time to evaluate whether the success rates improve. For Design II, which recorded strong success rates in 2019 and 2020 but underperformed in 2021, this may represent an outlier. Therefore, the 2022 success rates should be reviewed before deciding on interventions. For the other two modules that did not meet the benchmark, Analogue Electronics 1A and Strengths II, serious attention is required to address their performance, and interventions should be implemented as needed. Furthermore, the low success rate of Strengths I likely contributes to students being underprepared for Strengths II.

In the third-year modules, the average student success rates were above 70 percent for all modules except one—Strengths of Materials III, which had an average success rate of 51 percent, marking a nine-percentage point (pp) drop from Strengths II. This suggests that Strengths II may not be adequately preparing students for Strengths III. The average rate for Strengths of Materials III is based on the 2020 and 2021 cohorts, with a marked difference in performance: 28 percent for the 2020 cohort and 73 percent for the 2021 cohort. This significant variation may in part be explained by the disruption caused by the COVID-19 pandemic, as students in 2020 were restricted to online lectures, whereas students in 2021 returned to in-person learning. Overall,

the average student success rate for third-year modules exceeded that of second-year modules and first-year modules. The average student success rate across all academic years was 74 percent or higher, with third-year students achieving the highest rate of 86 percent. Considering that the DHET benchmark of 80 percent is often deemed unrealistic for engineering modules, a pragmatic target of 70 percent is more appropriate. These averages indicate a satisfactory level of cohort performance. The high third-year success rates may be attributed to senior students' strong foundation in their engineering knowledge, enabling them to effectively apply key concepts to new areas of study. Additionally, weaker students may have failed or dropped out earlier, leaving third-year cohorts comprised predominantly of higher performing students. The year 2020 marked the first time students were eligible to reach their third year of study under this programme. This cohort likely consisted of individuals who progressed without failing modules, making them a group of high achievers. However, further data from subsequent years should be gathered to provide a more comprehensive evaluation of third-year student success rates.

A small positive correlation was identified between English FAL and English HL, and Maths 1A and Maths 1B. Similarly, a small positive correlation was observed between Mechanics I and NSC Physics, as well as NSC Maths. In contrast, a medium positive correlation was found between Maths 1A, Maths 1B, and NSC Physics and NSC Maths. These findings indicate that higher NSC results are positively correlated with performance in first-year engineering modules. Since a positive correlation was observed, it was deemed appropriate to evaluate the suitability of the current entrance requirements. The analysis supports the conclusion that the current entrance requirement of a combined score of 120 is suitable, consistent with the findings of a previous investigation. The average success rates for most modules exceed 50 percent, except for Strengths I, which stands at 48 percent. Additionally, there is no significant variation in success rates between students in the '120–129' and '130–139' NSC P + M groups. However, students in the '160–200' group achieved notably higher success rates, reflecting their stronger academic background. For Strengths I, the success rate remains relatively consistent across the various NSC P + M groups, except for the '160–200' group, which performed significantly better.

This persistently low success rate for Strengths I may be linked to the broader trends of underperformance highlighted earlier, suggesting systemic challenges in this specific module. The current combined NSC Maths and Physics entrance requirement is appropriate but could be improved. An alternative approach—setting a minimum requirement of 60 percent for both Maths and Physics separately—may be worth considering to further refine the selection process. The inclusion of GA assessments in many exit-level modules raised initial concerns about their potential negative impact on student success and throughput. Specifically, there was apprehension that failing the GA assessment might directly lead to module failure, thereby affecting a substantial number of students. During the two-year study period (2020–2021), 23 students failed the GA assessments. Of these, 22 would have failed the module regardless of their performance on the GA assessment, indicating that the GA assessment did not contribute to their module failure. Only one student failed a module solely due to failing the GA assessment, and this isolated case does not present a statistically significant trend. It can therefore be concluded that the introduction of GA assessments did not have a notable adverse effect on student success or throughput during this initial investigation. Future studies with larger cohorts are recommended to gain deeper insights and validate these findings over extended periods.

The investigation evaluated the effectiveness of offering two first-year bottleneck modules, Strengths I and Mechanics I, in both semesters of the academic year to improve student progression and success rates. The analysis revealed that success rates for both modules were higher in the first semester compared to the second semester. This is to be expected, as the first-semester classes primarily comprised repeating students who had already engaged with the module content. However, this advantage is somewhat offset by the significantly lower number of students registered in the first semester. A notable issue is that many students who fail these modules during their initial second-semester offering do not retake them in the following first semester (S1 of the next academic year), somewhat limiting the potential impact of the intervention. If all students who failed these modules in the second semester were automatically re-registered for the next available offering in the first semester, the intervention could have greater potential to enhance success rates and progression. This approach warrants further study to evaluate its effectiveness in practice. The university's regulations allow students a maximum of five years to complete this three-year programme, meaning they can fail no more than two academic years. However, some students were found to attempt these first-year modules up to four times, making it nearly impossible for them to complete the degree within the permitted timeframe. This highlights the need for targeted measures, such as enhanced academic support or alternative intervention strategies, to mitigate this issue and ensure timely degree completion.

The entrance requirements for the new BET programme are higher than that of the old ND programme. The student success rates of the BET modules that were deemed similar to modules offered in the ND programme were compared, so as to determine whether the entrance requirements are appropriate. The student success rate in BET modules, in total, were higher in all four semesters when compared to similar ND modules. Overall, it can be said that the BET modules are more successful than the ND modules, although greater emphasis should be placed on Strengths of Materials. It can also be stated that the increase in entrance requirements for the BET programme has played an important role in its success rate increase and are appropriate.

Conclusion

This study has provided valuable insights into the BET programme, affirming its structural integrity while identifying key areas for improvement. Success rate analysis highlighted bottleneck modules like Strengths I that require targeted interventions, while the investigation of entrance requirements confirmed their general suitability, with room for refinements such as setting higher thresholds for NSC Maths and Physics. Graduate Attributes assessments had minimal impact on throughput, and back-to-back module offerings showed potential for improving progression, though further adjustments may enhance their effectiveness. Comparisons between ND and BET modules demonstrated significantly higher success rates in the BET programme, validating the positive effect of increased entrance requirements. These findings offer a strong foundation for targeted interventions and future research to further enhance student success and throughput. This study has several limitations that should be considered. The data collection spans a relatively short period (2018–2021), which restricts the ability to assess long-term trends, especially for third-year modules that only became eligible for analysis in 2020. The findings rely heavily on quantitative analysis, omitting qualitative insights like student and instructor feedback that could provide valuable context. The impact of external factors, such as the pandemic and online learning transitions, may have influenced module performance in ways that are difficult to separate from other factors. Additionally, while comparisons between BET and ND modules reveal significant differences in success rates, variations in curriculum design and student demographics make direct comparisons challenging.

Declarations

Interdisciplinary Scope: The interdisciplinarity is established by integrating engineering education, institutional policy, and data-driven evaluation within a pragmatic paradigm, offering practical solutions for student success and throughput, aligned with national frameworks and accreditation standards, relevant to engineering, education, and institutional effectiveness.

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