

MAPPING STUDENT PATHWAYS IN EXTENDED CURRICULUM PROGRAMMES: A SANKEY FLOW ANALYSIS (2016–2025)

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Abstract

In South Africa, Extended Curriculum Programmes (ECPs) are designed to enhance access, retention, and academic success for students entering higher education with varying levels of preparedness. The primary aim of this study was to visualise and interpret patterns of progression, retention, transfer, and dropout in order to inform evidence-based curriculum restructuring and programme design. The research shifted focus from legacy extended curriculum structures toward the development of newly introduced programme models, namely the Four-Year Bachelor of Commerce (BCom) Programmes and the Four-Year and Five-Year Bachelor of Science (BSc) Foundation Programmes. A retrospective cohort design was adopted using institutional administrative data collected across a ten-year period. The dataset comprised all first-time entering students registered in Extended Curriculum Programmes within the Sciences and Commerce streams. Descriptive statistics were utilised to summarise cohort characteristics and key performance indicators, while Sankey flow analysis served as the principal analytical and visualisation tool. This approach enabled the mapping of student transitions between academic levels, programme streams, and exit points, revealing both linear and non-linear pathways. The findings demonstrated that student trajectories were diverse and frequently non-sequential, with concentrated movement occurring within the first two years of study. Sankey visualisations highlighted recurring transition nodes and academic bottlenecks, as well as common transfer routes between disciplinary areas. Analysis of pathway-to-graduation data further revealed that a significant proportion of students achieved completion through indirect or extended routes, underscoring the need for increased curricular flexibility and integrated foundational support in early years of study. The results provide practical insights for academic planners and policy developers seeking to strengthen monitoring practices and enhance programme responsiveness to student needs.

Keywords: *Extended Curriculum Programmes, Cohort analysis, Sankey analysis, curriculum restructuring, retention.*

1. Introduction

From 2016 to 2024, the ECPs were comprised of four streams. Three streams were Bachelor of Science (BSc) Programmes and one, a Bachelor of Commerce (BCom) Programme. The BSc streams were; a) BSc Extended Physical Sciences, b) BSc Extended Mathematical Sciences and c) BSc Extended Biological and Agricultural Sciences. The two programmes were designed for students who are not academically prepared, but who have the potential to succeed and obtain their degree. The programmes include an additional year of study which aims to enhance students' basic knowledge and skills before they progress to more specialist studies in later years [DHET], 2013). Students who enroll in these programmes are afforded a greater opportunity for academic success, while also receiving dedicated support to assist them in bridging the gap between school and higher education (Briggs *et al.*, 2012; Engelbrecht *et al.*, 2014; Lubben *et al.*, 2010; Machika, 2001; Ogude *et al.*, 2019; Pearce, *et al.*, 2015).

In this paper, we traced the 2016-2025 cohorts of students from enrolment to graduation and presented the actual dropout figures over time and depict the migration trends of students within or outside the Faculties of Natural and Agricultural Sciences (NAS) and Economics and Management

This paper is a follow up to the work published by (Engelbrecht *et al.*, 2014) where the authors worked on five quantitative criteria for evaluating the extended programmes. For this paper only three quantitative criteria were used: retention, completion rate and migration to other qualifications /faculties till graduation.

2. Design

This is a retrospective cohort study using institutional administrative data analysed through descriptive statistics and Sankey flow visualisation.

3. Objectives

The aims of this study were to visualise and analyse patterns of student progression, retention, transfer, dropout and graduation within Extended Curriculum Programmes in South Africa with particular emphasis on the migration of students from extended curriculum streams into mainstream programmes. In doing so, the study sought to quantify the role and contribution of ECPs within the study university and to provide evidence-based insights to inform curriculum restructuring and the design of new four- and five-year degree programme models (Machika, 2001).

4. Methods

A retrospective cohort design was employed to analyse ten years of institutional data. This design is appropriate for examining longitudinal trends and identifying patterns in student progression over time.

The dataset comprised all first-time entering students enrolled in ECPs within the Sciences and Commerce streams between 2016 and 2026. Variables included programme enrolment, academic performance, progression status, and exit outcomes.

Descriptive statistics were used to summarise cohort characteristics, including retention rates, dropout patterns and throughput rates. Sankey flow diagrams were constructed to visualise student transitions across academic levels and programme streams.

5. Results and discussion

5.1. Results

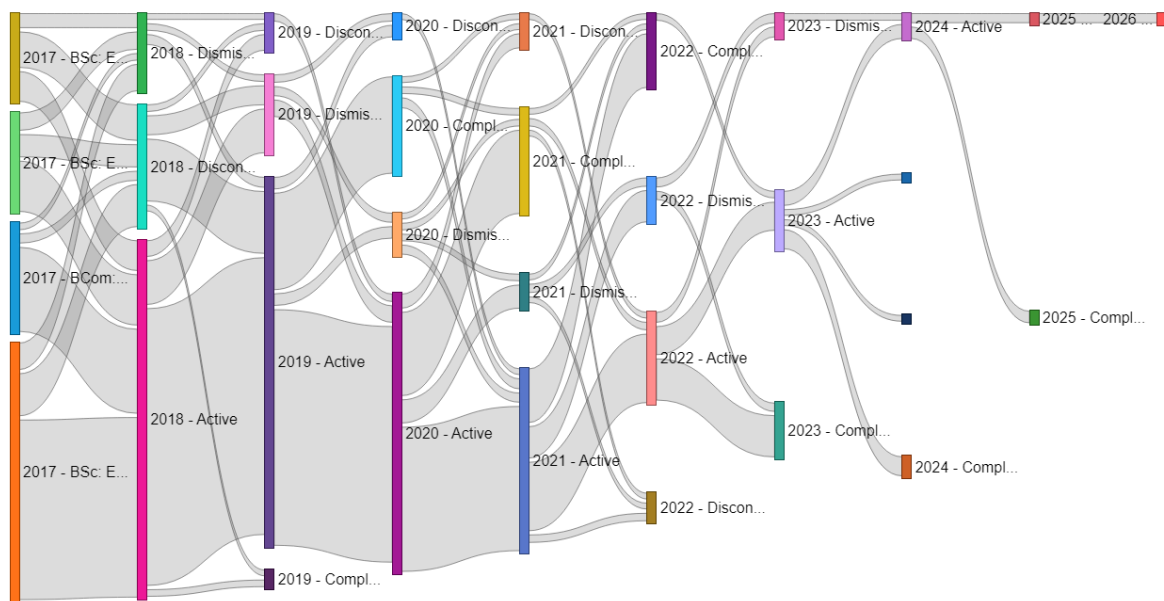
Student progression was highly non-linear. While some students followed expected pathways, many experienced interruptions (discontinuity, dismissal and leave of absence), including course repetition and programme transfers. The first two years emerged as critical periods, with the highest levels of movement and attrition. Table 1 summarises 2017 cohort of students' movement into the number of students retained at the end of each year, number of dropouts and the cumulative percentage of those who completed their degrees.

Table 1. 2017 cohort; data from enrolment to graduation.

2017 Cohort (644)	Retained	Drop-out (% cumulative)	Graduates (% cumulative)
2018	557	87(14%)	
2019	493	61(23%)	3
2020 (n+1)	324	58(32%)	111(18%)
2021 (n+2)	202	13(34%)	109(35%)
2022 (n+3)	111	30(39%)	61(44%)
2023 (n+4)	35	29(43%)	47(51%)
2024 (n+5)	8	9(45%)	18(54%)
2025 (n+6)	3	1(45%)	4(55%)

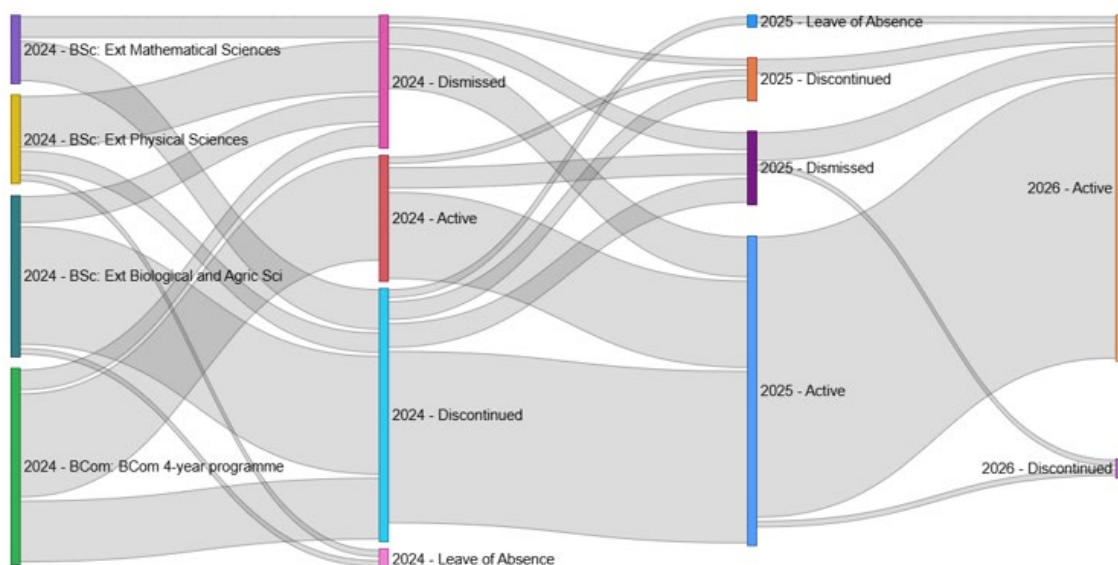
The Sankey diagram in Figure 1 depicts the vertical progression (year-to-year advancement), the lateral transfers (movement between programmes), the extended study pathways and the exit points (dropout or graduation) of undergraduate students who commenced their journey in 2017 academic year.

Figure 1. Sankey Diagram: Tracking 2017 – 2026 ECPs undergraduates.



There are frequent lateral transfers between Science and Commerce streams. Significant dropout occurred after the first year and throughout the study period as well as the multiple pathways leading to eventual graduation.

Figure 2. Sankey Diagram: Tracking 2024 – 2026 Tracking ECPs undergraduates.



In 2024, a dedicated Transition Academic Success Coach was appointed to provide targeted support to the 2024 student cohort from their second year of study through to graduation. The role of the coach includes monitoring and supporting academically at-risk students referred by academic staff, as well as coordinating intentional and responsive academic development workshops tailored to students' needs. Although the initiative is still in its early stages, preliminary observations indicate an improvement in student migration and progression patterns from the second year onwards when compared with the Sankey analysis of the 2017 cohort.

These findings highlight the complexity of student journeys and the limitations of linear measures of student success.

Based on the findings from the 2016 to 2023 cohort analysis, together with the recommendations made by external programmes review panel in 2021, management embarked on a programme rearticulation exercise and introduced 11 new programmes in 2025. These programmes developed from the disciplines and pathways through which ECPs students were most likely to graduate (Slabbert & Friedrich-Nel, 2015).

Table 1. Number of enrolled undergraduate students from 2016 to 2026 in the old and new programmes.

Foundation Programmes	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
BCom: BCom 4-year programme	112	117	250	260	290	286	245	288	248	202	199	2497
BSc (4-year): Chemistry 4-year programme										31	28	59
BSc (4-year): Ecology 4-year programme										34	34	68
BSc (4-year): Geoinformatics 4-year programme										24	21	45
BSc (4-year): Geology 4-year programme										34	30	64
BSc (4-year): Human Physiology 4-year programme										29	28	57
BSc (4-year): Mathematics 4-year programme										33	32	65
BSc (4-year): Meteorology 4-year programme										16	22	38
BSc (4-year): Physics 4-year programme										32	28	60
BSc: Ext Biological and Agric Sci	279	326	360	291	274	296	206	228	198			2458
BSc: Ext Mathematical Sciences	42	87	80	80	78	77	73	51	70			638
BSc: Ext Physical Sciences	106	114	136	121	133	148	93	87	91			1029
BSc Agric (5-year): Applied Plant and Soil Sci 5-yr										19	26	45
BSc Agric (5-year): Applied Plant and Soil Sci 5-yr										12	24	36
Total	539	644	826	752	775	807	617	654	607	466	472	7159

A notable proportion of graduates completed their degrees through extended or indirect pathways. Transfers to other programmes within the same faculty or across different faculties prolonged the time to graduation, with 50% (cumulative value) of enrolled students completing their first degree after eight years of study (n+4). These findings underscore the importance of flexibility in curriculum design and the value of providing multiple pathways to student success.

5.2. Discussion

The findings align with existing literature on non-linear student progression and the challenges experienced by underprepared students (Tinto, 1993; Letseka & Maile, 2008). The use of Sankey diagrams proved effective in visualising complex student trajectories and enhancing institutional understanding of student experiences.

The identification of bottlenecks in foundational modules suggests the need for enhanced academic support in early years. In addition, the high prevalence of lateral transfers suggests that students benefit from flexible opportunities to transition across programmes and faculties.

Importantly, the study demonstrates that successful programme reform can be driven by descriptive and visual analytics without relying on predictive modelling. This approach enhances transparency and accessibility for institutional decision-making (Siemens & Baker, 2012).

The transition from four legacy programmes to eleven newly structured offerings represents a significant institutional response to these findings. The revised model includes a shared first-year curriculum across ten programme streams, enhanced flexibility for student mobility, and integrated foundational support. These changes align with best practices in curriculum design that emphasises flexibility, inclusivity, and responsiveness to student needs (Biggs, 2014; Slabbert & Friedrich-Nel, 2015).

6. Conclusion

This study demonstrates the value of Sankey flow analysis in understanding student progression within Extended Curriculum Programmes. By revealing the complexity and diversity of student pathways, the study provides a strong empirical basis for curriculum reform.

The findings underscore the importance of early academic intervention, flexible programme structures, and continuous monitoring of student trajectories. As higher education institutions continue to widen access, data-driven approaches such as these will be essential to ensuring that access translates into student success (Siemens & Baker, 2012).

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