



## RESEARCH ARTICLE

## A Diagnostic Baseline Study of the Incoming FTENs Cohort at a Rural South African University

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ARTICLE INFO	ABSTRACT
Received: Jan 18, 2026	<p>This paper presents a comprehensive, data-driven analysis of the foundational competencies of the 2026 incoming cohort in the Faculty of Natural Sciences (FNS) at a Rural South African University. Drawing on 507 complete and valid responses to a standardised orientation assessment, the study examines performance across five domains: mathematics, physics, chemistry, biology, and academic soft skills. The analysis reveals a near-normal distribution of scores, with 52.8% of students scoring between 50 and 69, and 36% falling below the pass mark of 50. Departmental disparities are evident: Mathematical Studies &amp; Computing achieved the highest pass rate (75%), while Applied Sciences recorded the lowest (60%). A counterintuitive finding emerged: students in the highest Admission Point Score (APS) band (40–49) accounted for the most failures, challenging the assumption of linear predictability of prior academic achievement. The study identifies specific conceptual gaps, particularly in binary conversion, kinematics, and scientific definitions, and proposes a tiered, evidence-based intervention framework. The findings underscore the value of orientation assessments as diagnostic tools for curriculum alignment, early identification of at-risk students, and advancing equity-oriented academic support.</p>
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### INTRODUCTION

The transition from secondary to tertiary education is a critical juncture in students' academic trajectory. In South Africa, where historical inequities continue to shape educational access and outcomes, the need for institutions to understand and respond to the baseline competencies of incoming cohorts has never been more urgent (Boughey & McKenna, 2016). The Faculty of Natural Sciences (FNS) at a Rural South African University has introduced the practice of administering an orientation assessment to all first-year students, not as a gatekeeping mechanism, but as a diagnostic instrument designed to illuminate collective strengths, identify systemic knowledge gaps, and inform evidence-based pedagogical and curricular responses. This approach is considered as a foundational best practice for fostering student success and institutional effectiveness in higher education (Mohd Ghani et al., 2007; Cannon, R., & Newble, D., 2000; Ewell, P. T., 2009; Van der Meer, J. et al., 2010). This strategy represents a significant shift from a deficit-based model to an asset-based and developmental one. For a university, this diagnostic assessment approach transforms student data from a simple admissions metric into a strategic asset for continuous improvement and support, ensuring that all students receive equal support based on their academic needs. Further, this allows faculties and departments to make informed adjustments to their pedagogy and curricula, ensuring that teaching methods are responsive to students' actual needs (Ewell, P. T., 2009). This prevents the institution from making "unnecessary (and costly) programmatic changes" based on guesswork (Cannon, R., & Newble, D., 2000). The aggregated data from diagnostic assessments offer the university invaluable insights into the collective strengths and weaknesses of each new cohort (Van der Meer, J. et al., 2010). This intelligence enables programme-level recommendations and targeted

actions, such as shaping the development of first-year programs or academic support services. As one study notes, this data enables institutions to move beyond individual student support to implement systemic changes that benefit all students (Ewell, P. T., 2009). Framing the assessment as a diagnostic tool rather than a gatekeeping mechanism is crucial for building trust. It also signals to first entering students (FTENs) that the university is invested in their success from day one and is committed to providing the resources they need to thrive. This proactive, supportive stance is linked to improved student learning outcomes and overall program effectiveness (Mbodila, M., and Clever, N., 2025; Cannon, R., & Newble, D., 2000). For students, particularly those navigating the critical transition to higher education, a diagnostic assessment provides a structured opportunity for self-discovery and skill-building.

This paper reports on the findings of the 2026 FNS orientation assessment. It aims to: (1) describe the performance profile of the incoming cohort across academic domains and departments within the faculty; (2) identify specific conceptual areas of strength and deficiency; (3) examine the relationship between Admission Point Score (APS) and actual test performance; and (4) propose a strategic, data-informed framework for academic intervention and curriculum enhancement.

## LITERATURE REVIEW

### Diagnostic Assessment in Higher Education

Diagnostic assessment, when situated at the outset of an academic programme, serves functions distinct from summative or formative evaluation. Its primary purpose is not to grade or rank, but to reveal learners' cognitive and conceptual starting points (Black & Wiliam, 2018). This formative purpose is reinforced by broader educational scholarship, which emphasises that diagnostic assessments are deliberately low-stakes, pre-instructional tools designed to identify both strengths and areas for development, thereby enabling educators to tailor teaching strategies to individual needs (Inspera, 2024). In science education, diagnostic tools have been shown to uncover persistent misconceptions, particularly in threshold concepts such as chemical bonding, force and motion, and cellular processes (Hestenes, Wells, & Swackhamer, 1992; Taber, 2002). The Force Concept Inventory (FCI), developed by Hestenes and colleagues, remains a foundational instrument in this domain; recent studies continue to validate its utility in revealing that students across various educational contexts often hold pre-Newtonian or Aristotelian conceptions of force and motion, which persist despite traditional instruction (Taber, K., 2002). Similarly, Taber's (2002) work on chemical misconceptions provides a comprehensive framework for understanding how students develop alternative conceptions in chemistry, emphasising the need for targeted diagnostic approaches to inform pedagogical responses (Ma, H. et al., 2025). Recent systematic reviews further confirm that multi-tier diagnostic technologies are among the most effective means for assessing the depth of students' conceptual understanding across scientific disciplines, with four-tier diagnostic tools regarded as the most accurate method for identifying misconceptions (Bouzid, T., 2022; Ma, H. et al., 2025). These reviews also highlight that misconceptions remain prevalent among students at various educational stages, underscoring the ongoing need for robust diagnostic practices (Ma, H. et al., 2025).

Whittemore and Knafl (2005), in their foundational work on integrative methodology, argue that balanced, multi-domain assessment designs yield richer diagnostic data than single-discipline tests. Their framework has been widely adopted in educational research to synthesise evidence across multiple domains and to develop comprehensive evaluation instruments (Whittemore, R., & Knafl, K., 2005). The FNS orientation test, which integrates mathematics, physics, chemistry, biology, and soft skills, reflects this methodological pluralism. Such multi-domain approaches align with contemporary advances in diagnostic assessment, including frameworks that integrate diagnostic feedback, remedial instruction, and validation systems (Inspera, 2024). Moreover, emerging research explores how large language models and cross-domain diagnostic paradigms can address the "cold start" problem in new educational contexts, suggesting that multi-domain diagnostic data can facilitate the transfer of cognitive-state assessments across disciplines (Kelly, T., 2018). The idea

of capturing the academic profile of student readiness through the FNS orientation assessment exemplifies the shift towards integrated, evidence-based assessment practices that inform both pedagogical and curricular responses.

### **Admission Point Score as a Predictor**

The Admission Point Score (APS), derived from National Senior Certificate (NSC) performance, remains the primary metric for university admission in South Africa. However, its predictive validity has been questioned. Multiple studies suggest that while APS correlates moderately with first-year performance, it explains only a fraction of the variance, particularly in science programmes where prior knowledge of specific disciplinary content is more determinative than aggregate school performance (Van der Merwe & De Bruin, 2013). This limitation is underscored by empirical research demonstrating that between 2008 and 2015, approximately 50% of learners who achieved the required APS for admission to science programmes at a South African research-intensive institution failed to complete their degree requirements (Ajoodha, R., 2022). The same study revealed that the distributions of APS scores across different risk profiles overlapped by more than 80%, meaning that students with identical APS scores could subsequently be categorised as either 'no risk' or 'high risk' in terms of academic vulnerability (Ajoodha, R., 2022; Krügel, R., 2011). This finding leads researchers to argue that aggregating NSC subjects into APS scores "normalises the complexity of the subtle relations between the schooling system, learner attrition, and pre-schooling pedagogical dynamics," thereby obscuring the nuanced factors that genuinely influence student success (Ajoodha, R., 2022). However, this study identifies a gap in the existing literature and seeks to address it by contributing new empirical evidence to the field.

The predictive limitations of the APS are further illuminated by studies comparing school-leaving results with alternative assessment measures. Research on the National Benchmark Test (NBT) has shown that while both NSC results and NBT scores are useful predictors of first-year performance, the NBT's quantitative and academic literacy components provide better measures of academic potential for students whose NSC mathematics marks are close to the minimum admission requirements (Rankin, N. et al., 2012). This suggests that an admission criterion based solely on NSC marks may exclude students with genuine academic potential while admitting others who are insufficiently prepared for university studies (Rankin, N. et al., 2012). Similarly, in the context of nursing education, selection test results (including NBT domains) have been found to predict areas where students are likely to encounter difficulties and can inform tailored academic interventions, with NBT Mathematics, Academic Literacy, and NSC Life Sciences emerging as statistically significant predictors of first-year success (Bruce, Judith et.al, 2023). The value of domain-specific assessment is reinforced by research in accounting education, which found that prior knowledge of specific subjects, such as school-level accounting, predicts academic success, supporting the international literature that subject-specific prior knowledge is a stronger indicator of later academic performance than aggregate measures (Crous, C., et.al, 2021; Crous, C., and E. Goodchild, 2021).

The debate regarding the predictive power of school-leaving results versus alternative assessments is not without contention. Some institutional research suggests that NSC results remain a fair predictor of first-year success, particularly in reading-intensive courses or those emphasising group work and project-based learning (News24, 2011). However, the same research acknowledges that students entering with the NSC have struggled notably in mathematics and science courses, and that studies have shown 50% or more of the student intake require extended programmes to have a reasonable opportunity to succeed and graduate. (News24, 2011). This has led to the conclusion that the NBT should not be used as an alternative to the NSC, but rather as a complement for admission and the correct placement of lower-performing applicants (Rankin, N. et al., 2012). This body of evidence collectively points toward the need for more nuanced, domain-specific assessment practices that can complement aggregate school-leaving scores (Ajoodha, R., 2022).

The present study contributes new evidence to this debate by comparing APS bands against actual performance on a standardised, domain-specific assessment, thereby responding to calls for more

comprehensive tools that can identify vulnerable learners and inform evidence-based pedagogical responses.

### **The South African Higher Education and the Current Case Study Context**

South African universities face the dual challenge of massification and differentiation. While access has expanded significantly since the democratic transition, with black African student enrolment increasing from 40% in 1993 to 77% by 2021, success rates remain starkly stratified along lines of race, class, and geographic origin (Mabokang Liteboho, 2024). The Council on Higher Education (2021) has consistently documented that although equity of access has improved considerably, severe challenges to the realisation of equity of output remain (Alicia James, 2025; Kirby, N. F., & Dempster, E. R., 2018). Research indicates that the actual participation rate of black youth (18-29 years) in higher education stands at just 5.5%, compared to 17.7% for their white counterparts, while only 32% of black African students graduate within the expected timeframe, versus 64% of white students (Alicia James, 2025). These disparities persist despite policy interventions aimed at transformation, leading scholars to characterise the system as "highly inefficient" with a dropout rate of 32.4% across universities and only 56% of students completing a three-year degree within six years (Alicia James, 2025). The massification of higher education without adequate resourcing has, paradoxically, contributed to these poor outcomes, as institutions struggle to support increasingly diverse student bodies with finite resources (Kirby, N. F., & Dempster, E. R., 2018).

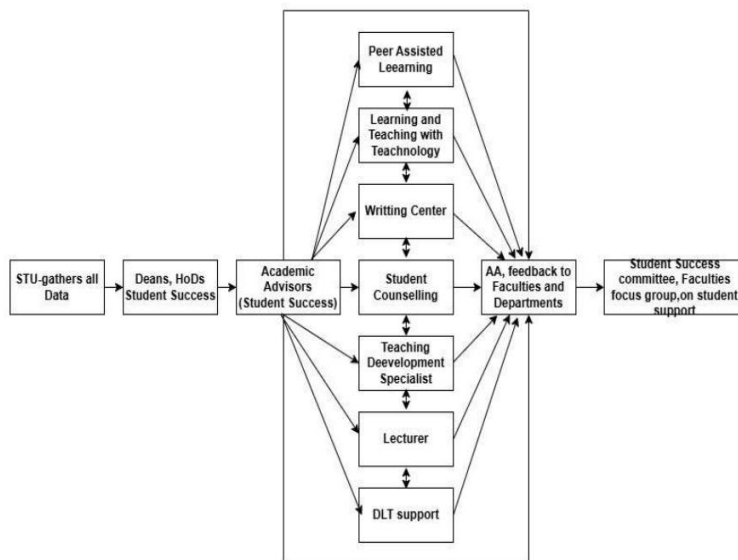
The institution, described in the case study, with its historical mission to serve rural and peri-urban communities in the Eastern Cape, enrolls a student body predominantly drawn from schools in quintiles 1–3, a demographic reality reflected in the 2026 cohort profile (WSU, 2024). Between 2020 and 2025, it maintained enrolment levels in which 72% to 83% of students came from the poorest public-school groupings, with approximately 60% of these students being female and over 80% receiving government funding through the National Student Financial Aid Scheme (NSFAS). This institutional profile positions WSU as a model for transformation in higher education, demonstrating that a university can achieve impact through accessibility rather than exclusivity (WSU, 2024). However, research by Scott, Yeld, and Hendry (2007) has long warned that school-leaving scores, including APS, are imperfect predictors of tertiary success, a finding reinforced by the present study. The aggregation of NSC subjects into APS scores has been criticised for normalising the complex relationships among schooling quality, learner attrition, and pedagogical dynamics, thereby obscuring the nuanced factors that genuinely influence student success. Within WSU's context, where students enter from significantly under-resourced educational backgrounds (WSU, 2024), the limitations of aggregate admission metrics are particularly pronounced, underscoring the need for diagnostic assessment tools that can identify specific knowledge gaps and inform targeted interventions to support student readiness and success (WSU, 2024; Alicia James, 2025; Kirby, N. F., & Dempster, E. R., 2018).

### **CONCEPTUAL FRAMEWORK**

This study focuses on administering a domain-specific orientation assessment (Mathematics, Physics, Chemistry, Biology, Soft Skills) to first-year students. The goal is not just to collect data, but to improve student readiness and faculty responses. To operationalise the diagnostic purpose of the orientation assessment and translate its findings into meaningful institutional action, the study uses a conceptual framework for a Referral System for Early Identification of At-Risk Students presented in Figure 1 (Mbodila, M., and Clever, N., 2025). This framework provides the operational model for what happens after the assessment.

This framework positions the FNS orientation assessment as the central data-gathering mechanism, the "STU-gathers all Data" node, from which diagnostic information flows outward to multiple layers of faculties (Denas and Hods) and student support services. These layers include Academic Advisors and Lecturers who engage directly with students, as well as specialised units such as the Writing Centre, Student Counselling, and Peer Assisted Learning, which provide targeted interventions based

on identified needs. Crucially, the framework incorporates a recursive feedback loop through which aggregated diagnostic data are channelled via Academic Analytics to Faculties, Departments, and the Teaching Development Specialist, thereby informing evidence-based pedagogical and curricular responses. This referral-based conceptual model is particularly apposite to the present study, as it provides a structured mechanism for moving beyond the limitations of aggregate admission scores like the APS. See illustrated in Figure 1,



**Figure 1: Framework for a referral system for early identification of at-risk students (Mbodila, M., and Clever, N., 2025)**

The purpose of using this conceptual framework is to establish clear pathways for referring students to appropriate support structures based on diagnostic evidence. In line with this study, the framework ensures that the orientation assessment in the FNS serves not merely as a gatekeeper but also as a catalyst for early identification of at-risk students and for a coordinated, data-informed approach to enhancing student readiness and success.

**Table 1: Schematic Representation of the Framework Process**

Stage	Actor in Framework	Activity Related to Your Study	Outcome
1. Discovery	STU gathers all the Data	The FNS Orientation Assessment identifies a specific misconception in Chemistry (e.g., covalent bonding).	Raw data collected.
2. Triage	Dean, HoDs, Academic Advisor	Dean, HoDs and Advisor review individual/group student reports and flag students for a "e.g Chemistry Refresher" workshop.	Individual/group student support initiated.
3. Intervention	Peer Assisted Learning (PAL) / Tutors	PAL sessions are redesigned to focus on "e.g Chemical Bonding" using diagnostic results as a lesson plan.	Students receive targeted help.
4. Analysis	AA, feedback to Faculties	The university's analytics team notes a trend: 40% of students fail the bonding questions annually.	Systemic problem identified.

5. Redesign	HoDs / Lecturers/ Teaching Dev.	The curriculum is adjusted; the first-year Chemistry module now includes a mandatory pre-lab on molecular structures.	Curricular change based on evidence (from the study).
6. Review	Student Success Committee	The committee monitors mid-year exam results to see if the intervention worked.	Continuous improvement cycle.

## METHODOLOGY

### Assessment Design

The orientation test comprised 80 items, each weighted equally. Questions were distributed across five domains: Mathematics (25%), Physics (20%), Chemistry (20%), Biology (15%), and Soft Skills (20%). Cognitive levels ranged from knowledge recall and comprehension to application, analysis, synthesis, and evaluation, following a modified Bloom's taxonomy (Anderson & Krathwohl, 2001). The integrative design, combining discipline-specific and interdisciplinary items, was informed by the balanced integrative methodology advocated by Whittemore and Knafl (2005).

### Scoring and Classification

A standardised scoring protocol was employed. Calculation-based questions permitted partial credit for correct methodology, rewarding analytical reasoning over mere computational accuracy. Performance was categorised into four bands: Needs Support (50–59), Adequate (60–69), Strong (70–79), and Excellent (80). Students scoring below 50 were classified as requiring intervention. Figure 2 below visualises how students performed across the 507 responses. It highlights the reported normal distribution pattern, with most students scoring between 60 and 69.

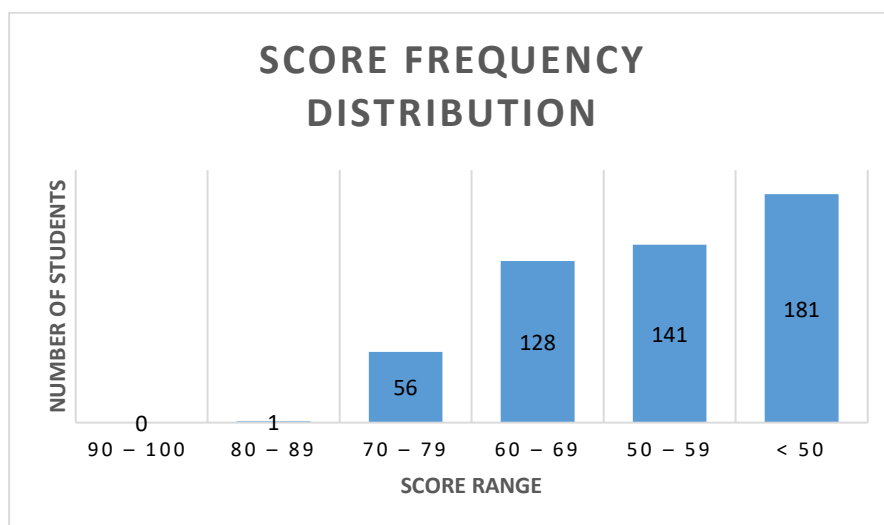
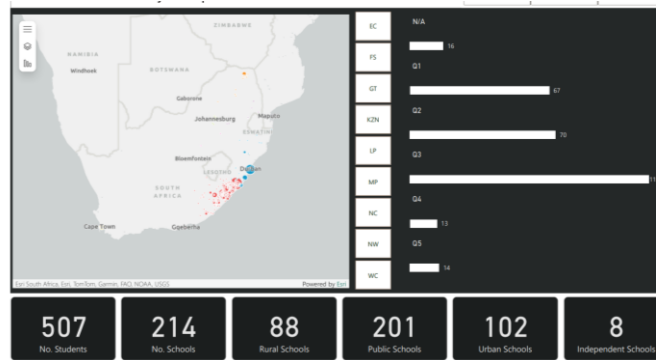


Figure 2: Score Frequency Distribution

### Participants and Data Collection

The assessment was administered online during orientation week, with a 90-minute time limit. The final dataset comprised 507 complete and valid responses, representing 100% of the FTENs participating in the assessment in this cohort. Timestamp validation confirmed authentic participation. Demographic data included departmental affiliation, qualification type, and APS band. The cohort was distributed across four departments: Biological & Environmental Sciences (30%), Mathematical Studies & Computing (25%), Applied Sciences (24.5%), and Chemical & Physical Sciences (20.5%). See Figure 3.



**Figure 3: FNS 2026 cohort profile**

Table 2 outlines the academic composition of students by department, providing insight into the number of students and the percentage of the cohort represented in each department.

**Table 2: Academic Composition per Department**

Department	Number of Students	Percentage of Cohort
Biological & Environmental Sciences	152	30.0%
Mathematical Studies & Computing	127	25.0%
Applied Sciences	124	24.5%
Chemical & Physical Sciences	104	20.5%
Total	507	100%

### Data Analysis

Quantitative analysis was conducted using descriptive and inferential statistics. Item difficulty (percentage correct) and item discrimination (item-total correlation) were calculated for each question. Comparative analysis across departments and APS bands employed measures of central tendency, dispersion, and cross-tabulation. All analyses were performed by the Institutional Research and Planning directorate using internally validated dashboards.

## RESULTS

### Overall Performance Distribution

The cohort's performance approximated a near-normal distribution with slight negative skew. The mean score was 51.54, the median was 50, and scores ranged from 10 to 80. A total of 181 students (36%) scored below 50, indicating the need for immediate academic support. The largest group (141 students, 27.8%) fell within the 50–59 band, followed by 128 students (25%) in the 60–69 range. Only 56 students (11%) achieved scores between 70 and 79, and a single student (0.2%) scored in the 80–89 band. No student attained a score of 90 or above. A summary representation is displayed in Tables 3 and 4.

**Table 3: Score Frequency Distribution**

Score Range	Number of Students	Percentage	Classification
90 – 100	0	0%	Outstanding
80 – 89	1	0.2%	Excellent
70 – 79	56	11%	Strong
60 – 69	128	25%	Proficient
50 – 59	141	27.8%	Needs Support
< 50	181	36%	Intervention Required

**Table 4: Statistical Summary**

Mean Score	Median Score	Min	Max	Score Range
51.54	50	10	80	0 - 100

These findings suggest that while basic competency is achievable for the majority, high-level academic distinction is rare under current conditions. The concentration of scores near the passing threshold indicates a homogeneous middle-performing cohort with limited dispersion at the upper extremes.

**Departmental Performance**

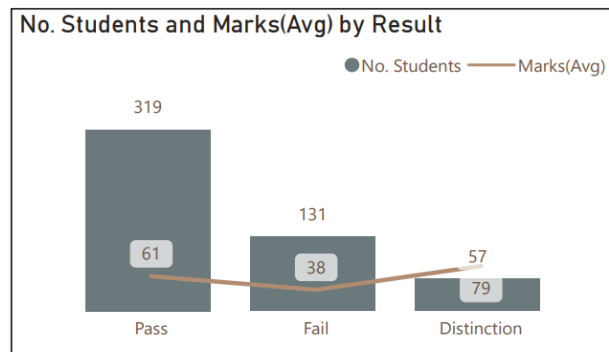
Significant variation was observed across departments. Mathematical Studies & Computing recorded the highest mean score (53.7), pass rate (75%), and merit rate (12%). Applied Sciences, despite having the lowest pass rate (60%), achieved the highest merit rate (17%), suggesting a bimodal distribution of high achievers and struggling students within the department. Chemical & Physical Sciences recorded the lowest mean (49.9) and merit rate (5%). Biological & Environmental Sciences, the largest department, demonstrated moderate performance (mean 50.9, pass rate 61%). Table 5 summarises the key findings on departmental performance.

**Table 5: Key Findings**

Department	Pass Rate	Rank	Performance Classification
Mathematical Studies & Computing	75%	1	Strong Performance
Chemical & Physical Sciences	62%	2	Moderate Performance
Biological & Environmental Sciences	61%	3	Moderate Performance
Applied Sciences	60%	4	Moderate Performance

From the above, these departmental disparities, while modest in absolute terms (a 15-percentage-point range in pass rates), point to differential preparedness aligned with disciplinary focus. However, the clustering of three departments within a narrow band (60–62% pass rate) suggests that foundational competency gaps are cross-cutting rather than department-specific.

Figure 4 below analyses the distribution of students and their average marks across three performance categories: *Pass*, *Fail*, and *Distinction*. The dataset reveals significant disparities in student performance: a clear majority achieve passing marks, while a substantial minority fail to meet the minimum requirements. The data suggest opportunities for targeted interventions to improve overall academic outcomes.



**Figure 4: Marks' Average by Category**

This finding shows a clear positive correlation between academic performance and cohort size, with the largest group, "Pass" (319 students), having a moderate average score of 61, suggesting this is the

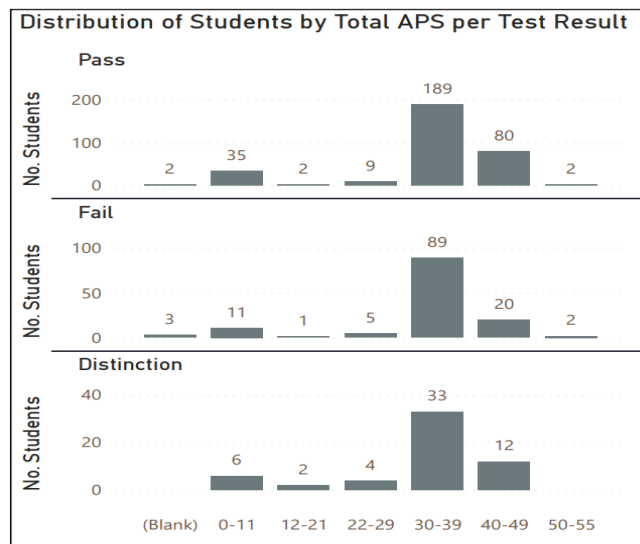
typical performance outcome. The "Fail" group, though smaller (131 students), has a significantly lower average of 38, indicating a distinct struggle or attainment gap. Remarkably, the smallest group (57 students) achieved "Distinction" with an average of 79, suggesting that excellence is less common. The inverse relationship between group size and average marks, where fewer students achieve higher averages, points to a performance distribution where top grades are selective, while the majority cluster around the passing range, with a substantial portion still at risk of failing. To have a full view of the analysis, the student distribution by result category is displayed in Table 6 below.

**Table 6: Student Distribution by Result Category**

Result Category	No. of Students	Percentage of Total
Pass	319	62.8%
Fail	131	25.8%
Distinction	57	11.2%
Total	507	100%

**APS and Test Performance**

This segmentation offers a granular view of the relationship between incoming academic metrics and subsequent assessment outcomes, delineating concentrations of success and failure within specific score ranges. The data illuminate critical patterns in cohort performance, revealing potential misalignments between entry-level qualifications and the course's academic demands. Figure 5 below presents the distribution of overall performance by APS band.



**Figure 5: Visual Overall Performance by APS Band**

Cross-tabulation of APS bands against test outcomes revealed unexpected patterns. The APS 30–39 band was the most prevalent across all result categories, accounting for 61% of passes and 56% of distinctions. Critically, the APS 40–49 band, representing students with the highest prior academic achievement, recorded the highest absolute number of failures (89 failures, 80% of all failures in this band). Conversely, students in the lowest APS bracket (0–11) were more likely to attain a distinction than those in the APS 12–21 or 22–29 groups. In the context of this study, it is important to note that students in this APS bracket (0–11) are potential candidates who updated their metric results and submitted them during the application process. A summary of the above analysis is provided in Table 7 below.

**Table 7: Overall Performance by APS Band**

APS Band	Pass	Fail	Distinction	Total
0-11	2	3	6	11
12-21	35	11	2	48
22-29	2	1	4	7
30-39	189	5	33	227
40-49	80	89	12	181
50-55	2	2	2	6

These findings challenge the assumption that APS reliably predicts success in tertiary assessment. They suggest that high prior achievement does not guarantee transfer of competencies to domain-specific, application-oriented tasks, and that motivational, contextual, or affective factors may mediate performance. To provide a granular view of the data, Table 6 displays student outcomes by Result Type, APS Band, Student Count, and Percentage of Category, and includes insightful observations.

**Table 8: Overall Performance by APS Band**

Result Type	APS Band	Student Count	Percentage of Category	Key Observations
Pass	30-39	189	61%	Peak performance band – majority of passing students
	40-49	80	26%	Second-highest concentration
	12-21	35	11%	Moderate representation
	0-11, 22-29, 50-55	2 each	<1% each	Low representation in extreme bands
Most passes occur between APS 12-49				
Fail	40-49	89	80%	Counterintuitive peak – high APS students failing
	12-21	11	10%	Moderate failure rate
	30-39	5	5%	Low failure rate in mid-band
	0-11, 22-29, 50-55	1-3 each	<3% each	Minimal failures in extreme bands
Potential causes: exam difficulty, anxiety, APS-test misalignment				
Distinction	30-39	33	56%	Primary distinction band
	40-49	12	20%	Moderate distinction rate
	0-11	6	10%	Notable – students outperforming admission scores
	22-29	4	7%	Low distinction rate
	12-21, 50-55	2 each	3% each	Minimal distinctions in these bands

## DISCUSSION

The findings of this study reveal a complex and nuanced portrait of incoming student preparedness within the Faculty of Natural Sciences, one that simultaneously affirms the value of diagnostic assessment and challenges conventional assumptions about the relationship between prior academic achievement and foundational competency. The near-normal distribution of scores, with 36% of students falling below the pass mark of 50, indicates that more than a third of the 2026 cohort enters university already positioned below the minimum threshold for academic success. This concentration of vulnerability at the lower end of the distribution, coupled with the clustering of the majority (52.8%) in the 50-69% band, suggests that while most students possess basic pass-level competency, relatively few demonstrate the advanced preparedness necessary for distinction-level performance. The departmental disparities are particularly instructive: the Mathematical Studies & Computing department's 75% pass rate likely reflects a natural alignment between students'

disciplinary interests and the quantitative demands of the orientation assessment, whereas the Applied Sciences department's 60% pass rate raises concerns about the fit between incoming students' foundational knowledge and the conceptual demands of an applied curriculum. These variations underscore the necessity of departmental-level analysis in interpreting institutional data, as aggregate institutional averages would obscure these meaningful differences.

Perhaps the most counterintuitive and theoretically significant finding is the inverse relationship between Admission Point Score (APS) and first-assessment performance among high-scoring students. That the highest APS band (40–49) contributed the greatest number of failures fundamentally challenges the assumption that prior academic achievement serves as a linear and reliable predictor of university readiness. Several interpretations merit consideration: high-APS students may have succeeded in the National Senior Certificate through examination strategies privileging rote memorisation over conceptual understanding; the aggregate APS may mask uneven subject-specific preparedness, with high overall scores concealing critical gaps in foundational science domains; or overconfidence may have led high-achieving students to underestimate the demands of an unfamiliar assessment format. These possibilities point to the limitations of aggregate admissions metrics as sole indicators of readiness and affirm the value of discipline-specific diagnostic assessment at the point of entry. The specific conceptual gaps identified—binary conversion, kinematics, and scientific definitions—provide actionable intelligence for curriculum design, revealing misalignments between secondary school curricula and the foundational assumptions of university science education. Collectively, these findings argue for a tiered, evidence-based intervention framework that differentiates support according to need: universal foundational bridging for all students in identified weak areas, targeted small-group tutorials for those scoring between 40 and 49%, and intensive individualised support for those below 40%. Such an approach advances equity-oriented academic support by ensuring that the promise of access is translated into the reality of achievement through responsive, data-informed pedagogy.

## CONCLUSION AND RECOMMENDATIONS

In light of this study's findings, it is recommended that the Faculty of Natural Sciences implement a tiered, evidence-based intervention framework that differentiates academic support based on the heterogeneous needs revealed by the orientation assessment. Specifically, universal foundational bridging should be introduced to all incoming students in the identified weak areas, binary conversion, kinematics, and scientific definitions, through mechanisms such as compulsory online modules or embedded curriculum refresher sessions. For students scoring between 40 and 49%, targeted small-group tutorials should be deployed to address conceptual remediation, while those falling below 40% require intensive individualised support, including peer mentoring and extended academic development programmes. Furthermore, the departmental disparities observed, particularly the low pass rate in Applied Sciences and the paradoxical failure of high-APS students, warrant disaggregated monitoring and tailored pedagogical responses at the departmental level rather than institution-wide blanket interventions. It is also recommended that admissions policies be revisited to recognise the limitations of aggregate APS scores, potentially supplementing them with discipline-specific diagnostic assessments that better predict readiness for the conceptual demands of university science education.

In conclusion, this study affirms the value of orientation assessments as diagnostic tools for surfacing the hidden contours of incoming student preparedness, challenging simplistic reliance on prior academic achievement and exposing critical conceptual gaps that, if left unaddressed, undermine equitable access to success. For this rural South African university, the path to improved student outcomes lies not in lowering standards but in deploying data to align support with need, ensuring that the promise of widened access is fulfilled through responsive, equity-oriented pedagogy that meets students where they are and scaffolds their journey to where they need to be.

### Author' Contribution

The author conceptualised the paper, conducted the literature review, and designed the framework and methodology. He drafted the manuscript, developed the discussion and recommendations, and approved the final version for submission.

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