FORMATIVE ASSESSMENT AND RESILIENCE: SUPPORTING AT-RISK MATHEMATICS STUDENTS AT NUS

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ABSTRACT

This study examines whether a mid-semester "At-Risk" protocol grounded in formative assessment can enhance academic recovery among foundation mathematics students at the National University of Samoa. Ninety-nine students (41 at-risk; 58 not-at-risk) were tracked across three checkpoints (Week 7, Week 14, Final Exam) using descriptive statistics, Pearson correlations, and simple linear regression. Early coursework strongly predicted final outcomes (Week 7 → Final: r = .80, R^2 = .63, p < .001), though predictability was lower for at-risk students ($R^2 \approx$ .42). Mid-semester improvement correlated moderately with final performance (Week 14 → Final: r = .51, R^2 = .26, p < .001). This study demonstrates that resilience-informed formative assessment can shift academic trajectories for underprepared learners in small-island higher education systems. These findings indicate that early diagnostic checkpoints and structured feedback cycles should be adopted as standard practice across resource-constrained higher education systems to strengthen academic resilience and improve success rates for at-risk mathematics learners.

KEYWORDS: Formative Assessment · Resilience · At-Risk Students · Feedback Literacy · Pacific Education · Higher Education Equity.

INTRODUCTION

Supporting at-risk learners in Foundation Mathematics remains an urgent priority in Pacific higher education, where early performance strongly predicts persistence and completion. Student attrition and academic underperformance are ongoing challenges in higher education globally, but they are particularly acute in small island developing states such as Samoa. In the Pacific context, these issues are compounded by infrastructural limitations, limited access to

academic resources, inconsistent teacher preparation, and socio-cultural expectations that often compete with study time. Students may enter tertiary education underprepared in core academic areas, especially mathematics, due to varying curriculum quality and lack of consistent secondary-school support (Cassells, 2018; Milne et al., 2012).

At the National University of Samoa (NUS), foundation-level mathematics courses serve as critical academic gatekeepers. These courses determine whether students can progress to further study in science, technology, commerce, or teacher education. Each semester, a significant proportion of students fail to meet the minimum pass threshold in the HMA030 Foundation Mathematics course, putting them At-Risk of exclusion or prolonged academic delay. These outcomes are not only a loss for the students themselves but also undermine national education goals related to equity, inclusion, and workforce readiness.

To address this issue, NUS has implemented an "At-Risk Intervention Protocol" aimed at identifying underperforming students midway through the semester and providing them with targeted academic support. The protocol focuses on formative assessment as a key strategy, one that emphasizes early feedback, developmental guidance, and sustained engagement with struggling learners.

This study investigates the effectiveness of that protocol in 2023, asking whether formative assessment, when strategically deployed, can meaningfully influence the academic outcomes of students identified as at-risk. Grounded in resilience theory, the study views academic recovery as a dynamic process shaped by the interaction between institutional support and student engagement. The goal is not only to evaluate outcomes but also to inform more robust, contextually relevant interventions for Pacific higher education systems.

To foreground the research problem rather than administrative detail, extended process mechanics (routing, sign-offs, internal forms) are summarized in Appendix A. Here we focus on student experience, the intervention's formative components, and measurable learning outcomes.

Background

In the Samoan higher education context, "at-risk" students are those who demonstrate early academic underperformance or disengagement and are likely to fail if timely support is not provided. This risk status is shaped by multiple intersecting factors: personal challenges (e.g.,

low self-confidence, health issues), situational barriers (e.g., family obligations, lack of private study space), and institutional limitations (e.g., limited student services, large class sizes). These challenges are common across Pacific Island universities and have been shown to significantly increase the probability of academic failure and eventual dropout (Ajjawi et al., 2020; Cassells, 2018; Milne et al., 2012).

In mathematics education, these risks are further amplified by cumulative learning gaps. Students who struggle with foundational skills in algebra, fractions, or number operations often find it difficult to catch up in time for high-stakes assessments. Research indicates that students are frequently unaware of their weaknesses until formal feedback is provided, by which time recovery may be difficult (Cassells, 2018; Brookhart, 2008).

As a mathematics educator at the National University of Samoa, I have personally witnessed many students arrive with determination but struggle silently until Week 7; when it is often too late to recover without intervention. These experiences informed my interest in early, formative strategies to disrupt this downward trajectory. The At-Risk Intervention Protocol used by NUS is designed to identify and support these students midway through the semester. It is grounded in the belief that resilience can be cultivated when students receive timely, actionable feedback and experience genuine academic care and support.

This background provides the foundation for the present study, which examines whether formative assessment and structured academic support can improve the outcomes of students identified as at-risk in HMA030 during the 2023 academic year.

At-Risk Process

The formal identification of at-risk students at the National University of Samoa is operationalized through a structured mechanism known as the Week 7 At-Risk Report. This internal reporting system is triggered midway through the semester and enables lecturers to flag students who are underperforming or disengaged based on coursework results up to that point.

Students are classified as **"At-Risk"** if they have:
- Scored below 50% in cumulative coursework assessments;
- Missed major assessments such as tests or assignments without valid justification; or
- Demonstrated poor attendance or lack of participation in tutorials and support

sessions.

Lecturers initiate the process by collecting the At-Risk template from the Faculty Secretary, reviewing each student's performance against expected coverage (approximately 25% of the total course grade by Week 7), and documenting any deviations. Cases where lecturers themselves are behind on assessment delivery are also flagged and addressed administratively.

Once reports are completed, they are submitted to the Deputy Vice-Chancellor (Academic & TVET) and routed to relevant offices, including Student Academic Services and the Quality Assurance Unit. For small classes, lecturers are encouraged to meet with students individually to discuss strategies for academic recovery. For larger cohorts, students are referred to centralized support services, such as tutoring units or counseling staff.

The At-Risk Report serves three primary functions:

- **Identification –** It enables the institution to detect early signs of academic failure using performance thresholds.
- **Intervention –** It allows for the deployment of support mechanisms, including remedial instruction, individualized feedback, and referrals to student services.
- **Accountability –** It holds both lecturers and students accountable for progress and ensures transparency in instructional delivery.

As an institutional mechanism, this process reflects best practices in academic monitoring and aligns with international literature emphasizing the importance of early detection systems (Cassells, 2018; Milne et al., 2012). This study investigates whether the interventions triggered by this process in 2023 led to measurable improvements in student performance by the end of the semester.

This paper is organized into five sections. Section 2 reviews international and Pacific literature on early detection, formative assessment, and academic resilience, culminating in the conceptual model guiding the study. Section 3 outlines the methodology, including the cohort design, assessment structure, and analytic procedures. Section 4 presents the results across the three performance checkpoints, while Section 5 discusses their implications for teaching and institutional practice. Section 6 concludes with key recommendations and a call to action.

Research Questions

This study aims to evaluate the effectiveness of formative assessment and academic intervention strategies in improving the performance of students identified as At-Risk during the 2023 semester 1 of HMA030 at NUS. It is guided by the following research questions:

1. To what extent does formative assessment influence the academic performance of at-risk students between Week 7 and the final examination?

2. What trends and relationships can be observed across Week 7, Week 14, and Final Exam performance among at-risk students?

3. Based on the 2023 intervention data, what recommendations can be made to strengthen formative assessment practices for at-risk learners in similar contexts?

The following section reviews the evidence on early detection, formative assessment, and resilience-building in higher education, themes that collectively inform the conceptual model guiding this study.

REVIEW OF THE LITERATURE

Introduction

Academic underperformance is a persistent concern in higher education, particularly among students classified as "At-Risk" due to low grades, weak engagement, or inconsistent participation in coursework. One widely endorsed strategy to support such learners is formative assessment; an instructional process that emphasizes early, low- stakes feedback, opportunities for self-correction, and frequent monitoring of student progress. A strong body of international research affirms the positive impact of formative assessment on learning outcomes, especially when used systematically and coupled with high-quality feedback (Black & Wiliam, 1998; Brookhart, 2008; Hattie & Timperley, 2007).

In mathematics education, formative assessment is particularly valuable due to the cumulative and sequential nature of learning. Misunderstandings in foundational concepts (e.g., algebra, fractions) often compound over time, and summative assessments may come too late for meaningful remediation. Formative strategies such as diagnostic quizzes, worked examples, one-on-one feedback, and scaffolded tasks are essential for identifying misconceptions early and guiding students toward mastery (Cassells, 2018; Wiliam, 2011).

Despite this global emphasis, the practical application of formative assessment in Pacific Island contexts remains underexplored. In Samoa, students face unique challenges that are

not always visible in conventional academic monitoring systems; such as obligations to family villages, limited access to private study environments, and cultural norms that may discourage questioning or help-seeking behaviors. These factors can inhibit timely responses to feedback and reduce the effectiveness of traditional academic interventions.

While the global literature on formative assessment and student resilience is well-established, there is a growing body of Pacific-focused research that highlights how local challenges shape student engagement and outcomes. For instance, Cassells (2018) found that formative interventions in mathematics courses at the University of the South Pacific significantly improved student performance, particularly among those from under- resourced backgrounds. Similarly, Lee Hang and Bell (2015) demonstrated that written formative feedback was more culturally appropriate and effective for Samoan students than traditional oral methods. Milne et al. (2012) emphasized that students who did not log into learning platforms during the first week of university study were far more likely to fail, highlighting the value of early identification in blended Pacific classrooms. These studies underscore the importance of tailoring formative assessment and academic support practices to the cultural and infrastructural realities of the Pacific region.

This study builds on emerging Pacific scholarship and draws on resilience theory (Masten, 2001) to understand how formative assessment may contribute not just to academic performance, but also to students' capacity to adapt and recover from early failure. Resilience theory views student success not as a fixed trait, but as a dynamic process influenced by the interplay of personal motivation, institutional support, emotional scaffolding, and culturally relevant pedagogies (Benard, 2004; Pianta & Walsh, 2014).

Accordingly, this literature review is organized around four interconnected themes that form the conceptual basis of this study:

1. **Early detection and academic monitoring** – how institutions identify students At-Risk of failure using performance thresholds, behavioral indicators, and learning analytics (Section 2.2);

2. **Formative assessment and feedback as developmental tools** – how feedback practices influence learning, motivation, and engagement, particularly in mathematics (Section 2.3);

3. **Resilience-building through teacher relationships and support systems** – how emotionally affirming interactions and sustained support foster academic persistence among at-risk learners (Section 2.4); and

4. **Theoretical foundations and practical applications** – how resilience theory provides a

lens for understanding the effectiveness and limitations of formative assessment (Section 2.5).

Together, these strands provide a comprehensive framework for analyzing whether formative assessment; when embedded in a structured support protocol; can meaningfully improve the academic outcomes of at-risk students at the National University of Samoa.

Together, these studies show that early detection systems work best when they combine timely performance checkpoints with actionable feedback, which directly informs the structure of this study's Week 4–7 diagnostic stages.

Early Detection and Academic Monitoring

Effective support for at-risk students begins with early and accurate identification. Academic failure rarely occurs without warning; signs of disengagement or difficulty are often evident through assessment results, missed assignments, poor attendance, or declining participation. Institutions that implement structured early-warning systems are more likely to intervene in time to reverse negative academic trajectories (Finn & Rock, 1997; Cassells, 2018).

In mathematics education, where concepts are built sequentially, timely monitoring is especially critical. A student who falls behind in algebra or number operations by Week 4 may struggle to catch up before the final examination. Cassells (2018) found that first- year mathematics students at the University of the South Pacific showed significantly higher pass rates when early detection was paired with structured tutoring and feedback interventions. Similarly, Milne et al. (2012) demonstrated that students who did not access online learning platforms during the first week of a course were disproportionately represented among final failures; highlighting the power of behavioral data as a predictor of academic risk.

More recently, Herodotou et al. (2019) have shown that learning analytics systems can use data such as login frequency, assessment submissions, and time-on-task to generate predictive alerts that allow instructors to intervene before formal assessments even occur. These data-driven approaches are gaining traction globally, but they must be contextualized within each institution's infrastructure, culture, and curriculum.

At the National University of Samoa (NUS), early identification is formalized through the Week 7 At-Risk Report, a faculty-wide initiative that flags students who have scored below 50% in coursework, missed core assessments, or failed to meet tutorial requirements. While

Week 7 may appear late compared to LMS-based alerts used elsewhere, it marks the point when roughly 25% of the coursework has been delivered and students have sat at least two formal assessments. It therefore serves as a mid-semester diagnostic checkpoint; allowing for targeted interventions while there is still time for meaningful academic recovery.

This structured identification process aligns with international recommendations for data-informed academic monitoring (OECD, 2021), while also being tailored to the instructional pace and resource constraints typical of Pacific higher education. By combining performance metrics with lecturer judgment, the Week 7 report offers a practical approach to early detection; though its success ultimately depends on what actions follow.

Early detection improves intervention success only when combined with structured follow- up and lecturer engagement, highlighting the need for systemic; not episodic; monitoring practices in Pacific universities.

Formative Assessment and Feedback as Developmental Tools

Formative assessment is widely regarded as one of the most effective strategies for improving student learning outcomes; particularly among those who are underperforming or academically disengaged. Unlike summative assessments, which are primarily evaluative, formative assessments are diagnostic, developmental, and iterative. They are designed not just to measure learning, but to promote it by helping students recognize their strengths, identify misconceptions, and take action to improve (Brookhart, 2008; Wiliam, 2011).

In mathematics education, formative assessment is especially critical. The subject's hierarchical structure means that students who fall behind in early topics; such as fractions, indices, or algebra; often struggle to engage with more advanced content. Short quizzes, scaffolded tasks, worked examples, and self-check practice exercises are among the most effective formative tools. However, their impact depends heavily on the quality and timing of feedback provided (Hattie & Timperley, 2007).

Feedback is most effective when it is specific, timely, and forward-focused; guiding students not only on what went wrong but on how to improve. Yet, research shows that students do not automatically know how to interpret or act on feedback. This has led to increasing attention on the concept of feedback literacy; defined as a student's ability to understand, value, and use feedback productively (Carless & Boud, 2018). For students who are already struggling or overwhelmed, simply receiving comments is not enough; they require guided conversations and opportunities to apply the feedback in meaningful ways.

In the Pacific context, Lee Hang and Bell (2015) argue that formative assessment must be both academically useful and culturally appropriate. In their study of Samoan learners, they found that written feedback; delivered in respectful and explanatory language; was more effective than verbal feedback, which some students found confrontational or confusing. This insight aligns with broader research on Pacific pedagogy, which emphasizes relational engagement, non-verbal cues, and high-context communication styles (Thaman, 2003).

At the University of the South Pacific, Cassells (2018) reported that embedding frequent formative assessments into first-year mathematics courses improved student outcomes significantly; particularly when students were given time to reflect on feedback and reattempt the tasks. These findings support the view that formative assessment must be purposefully embedded, not simply appended to summative tasks.

Within the HMA030 Foundation Mathematics course at NUS, formative assessment plays a central role in the mid-semester intervention process. Students identified as At-Risk are given diagnostic feedback on their weaknesses; often derived from earlier test scripts; and receive personalized tasks that align with those gaps. Tutorials are then structured around common errors or misconceptions. This approach reflects a growing shift in Pacific tertiary education toward assessment for learning, rather than simply assessment of learning.

Implications for Formative Assessment PracticeRel

Formative assessment enhances mathematics learning through diagnostic feedback and re-attempts, yet its efficacy depends on feedback literacy and culturally attuned communication.

Building Resilience Through Teacher Relationships and Support Systems

Resilience in education refers to a student's capacity to persist, adapt, and succeed despite adverse conditions. For students At-Risk of failure, resilience is not simply a personal trait; it is the product of dynamic interactions between individual effort and the quality of support systems that surround them (Masten, 2001). These systems include teachers, tutors, institutional staff, and peer networks, all of whom play a role in helping students reframe challenges, access resources, and maintain hope.

According to Benard (2004), three key protective factors shape student resilience: (1) caring and supportive relationships, (2) high expectations, and (3) opportunities for meaningful participation. When students feel that someone at the institution believes in their potential,

offers constructive guidance, and provides opportunities to recover academically, their motivation and effort increase substantially. These principles are echoed in Pacific education literature, which emphasizes the role of relational engagement, cultural respect, and non-confrontational communication in supporting student well-being (Thaman, 2003; Lee Hang & Bell, 2015).

Kahu (2013) extends this understanding through a multi-dimensional model of student engagement that includes:

- **Affective engagement**: emotional connection to learning, including feelings of belonging, hope, or anxiety.

- **Behavioral engagement**: participation in activities, attendance, and academic persistence.

- **Cognitive engagement**: the degree of mental investment and self-regulation students apply to their studies.

These dimensions are interrelated and heavily influenced by the quality of student- teacher interactions. For example, students who feel embarrassed by failure or intimidated by lecturers may disengage emotionally, even if support services are technically available.

In Samoa, many students experience pressure to contribute to family and village obligations, often placing academic responsibilities second. Others lack private study spaces or digital access, reducing their ability to revise or seek clarification outside class hours. In such contexts, teacher relationships are not optional extras; they are core enablers of persistence. Regular check-ins, affirming language, praise for effort, and patience in feedback delivery all contribute to a student's belief that success is still possible.

Within the HMA030 At-Risk Protocol, resilience-building is embedded through tutorial discussions, personalized feedback, and informal one-on-one conversations. These interactions are designed not only to address academic gaps but also to restore student confidence and motivation. This reflects the broader view that resilience is not built through discipline alone; but through affirmation, connection, and structured opportunity.

Implications for Resilience in Pacific Higher Education

Resilience in Pacific higher education emerges through relational care, affirmation, and second-chance opportunities that restore student confidence alongside cognitive skill.

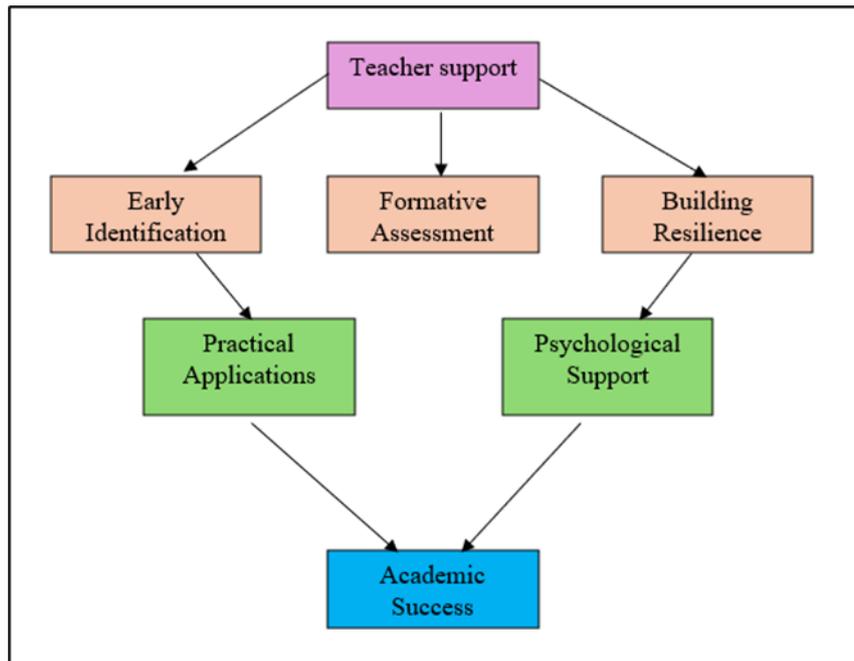Theoretical Foundations and Practical Applications

Figure 1: Theoretical Framework for Supporting At-Risk Students at NUS.

This study is grounded in resilience theory, which views student success not as a fixed attribute, but as a process of positive adaptation in the face of adversity (Masten, 2001). In this framework, resilience emerges when students are supported by protective factors; such as strong relationships, clear expectations, emotional encouragement, and opportunities for academic recovery. These factors interact dynamically with a student's personal agency and environmental conditions to shape outcomes.

Rather than framing at-risk students in deficit terms; as "failing" or "lacking"; resilience theory encourages educators to ask: *What supports are missing?* and *How can the institution respond?* This shift from blame to design aligns with Benard's (2004) ecological model, which emphasizes the role of systems; classroom climate, teacher behavior, institutional policy; in cultivating or undermining resilience.

In mathematics education, where failure is often internalized as personal inadequacy, this theoretical lens is particularly useful. Students who struggle in the first half of the semester may disengage entirely unless they receive feedback that not only explains their mistakes but also rebuilds their confidence. As Pianta and Walsh (2014) argue, recovery is not automatic; it must be scaffolded through intentional pedagogical design.

In the context of the HMA030 course at NUS, the At-Risk Protocol can be understood as a

practical embodiment of resilience theory. The Week 7 checkpoint serves as both a diagnostic moment and an invitation to re-engage. Feedback sessions, targeted assessments, and tutorial support function as protective structures designed to enable academic turnaround. By giving students multiple chances to succeed, and by affirming their potential rather than focusing solely on their deficiencies, the intervention reflects a resilience-based approach to higher education support.

This theoretical orientation also informs the study's analytic framework. Rather than only measuring raw improvement, the research examines performance progression over time (Week 7 → Week 14 → Final Exam) and investigates whether formative interventions aligned with resilience principles (e.g., feedback, support, opportunity) lead to measurable outcomes. This positions the study within a broader movement in education research toward strength-based, equity-driven interventions; particularly in under-resourced contexts like the Pacific.

To synthesise the key themes from the literature, Figure 2 presents a conceptual model showing how early detection, formative assessment, resilience factors, and institutional support interact within the NUS At-Risk Intervention.
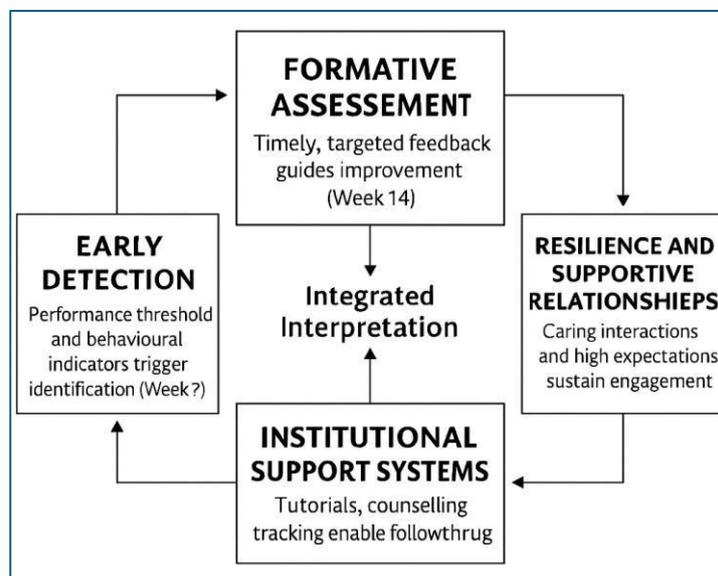

Figure 2 Conceptual Model Linking Literature Themes to the NUS At Risk Intervention.

This conceptual model integrates four themes from the literature review and shows how they interact to support at-risk students in the HMA030 course:

1. **Early Detection**

Performance thresholds and behavioural indicators (e.g., missed assessments) trigger the first diagnostic checkpoint (Milne et al., 2012).

2. **Formative Assessment**

Timely, targeted feedback identifies misconceptions, supports self-correction, and provides actionable next steps (Wiliam, 2011; Brookhart, 2008).

3. **Resilience and Supportive Relationships**

Caring lecturer–student interactions, high expectations, and opportunities to recover promote emotional engagement and persistence (Benard, 2004; Kahu, 2013).

4. **Institutional Support Systems**

Tutorials, counselling referrals, moderated assessments, and tracking mechanisms create the structural environment that enables follow-through.

Integrated Interpretation:

The model illustrates how early detection initiates support, formative assessment provides direction for improvement, resilience factors sustain student motivation, and institutional structures ensure continuity. These four elements interact dynamically from Week 7 to Week 14 and collectively influence a student's likelihood of academic recovery by the Final Exam.

These themes collectively inform the analytic focus of the methodology that follows, particularly the emphasis on early indicators and structured mid-semester feedback.

CONCLUSION

The literature reviewed in this chapter highlights four key dimensions of effective support for at-risk students: early identification, formative assessment, resilience-building, and the theoretical grounding of interventions. While there is strong international consensus on the value of formative assessment, the literature also cautions that feedback alone is insufficient; especially for students facing structural, cultural, or psychological barriers to academic success. Meaningful improvement depends not only on timely feedback, but also on whether students feel supported, capable, and motivated to act on it.

In the Pacific context, research by Cassells (2018), Milne et al. (2012), and Lee Hang & Bell (2015) emphasizes the need to tailor interventions to local realities, including cultural preferences in communication, limited resources, and competing life obligations. These

insights underscore the importance of context-specific strategies that are not only pedagogically sound, but also emotionally and relationally responsive.

Resilience theory provides a useful lens for integrating these dimensions. It shifts the focus from individual weakness to systemic support, encouraging institutions to build structures that affirm potential, scaffold recovery, and create second chances. This study adopts that lens to examine how formative assessment; when embedded within a structured intervention protocol; can influence academic trajectories for at-risk students at NUS.

Building on the conceptual foundations outlined in this chapter, the next section describes the study's methodology, including the context, participants, intervention design, and the statistical techniques used to evaluate academic performance over the 2023 semester.

In contrast to global findings that assume ready access to learning analytics and robust student services, Pacific studies (e.g., Cassells; Lee Hang & Bell; Milne et al.) emphasize cultural communication preferences, limited infrastructure, and competing obligations. Our application of resilience theory therefore operationalized protective factors as: (a) respectful written feedback with clear next steps, (b) structured second-chance opportunities aligned to diagnosed gaps, and (c) relationship-based check-ins to sustain engagement.

METHODOLOGY

This study employed a quantitative exploratory research design to investigate the effectiveness of formative assessment and early intervention strategies in supporting at- risk students enrolled in the Foundation Mathematics course (HMA030) at the National University of Samoa. The research focused on the relationship between students' early performance in coursework assessments and their final academic outcomes. By identifying students' At-Risk of failure mid-semester and examining their progression, the study aimed to assess whether early academic indicators could be used to support targeted interventions.

Participants and Context

Participants included 99 students who were officially enrolled in the HMA030 course during the semester under review. All participants had successfully completed the Samoa School Leaving Certificate (SSLC) examination, the national standard for university entry in Samoa and a prerequisite for enrollment in the course. The students' academic performance was monitored through coursework assessments administered during the first half of the semester:

- Assignment 1 (4%) – Released in Week 1, due in Week 3
- Test 1 (12%) – Administered in Week 4.

- Test 2 (12%) – Conducted in Week 7.

These assessments collectively contributed 28% of the total coursework mark.

Students were classified as **"At-Risk"** if they scored below 14%;the midpoint of the cumulative coursework completed by Week 7. The assessment structure used to identify at-risk students is summarized in Table 1, outlining the timing, weight, and format of each task contributing to the cumulative coursework mark by Week 7. This threshold served as a performance benchmark based on institutional practice and formative assessment principles. At-risk identification occurred during Week 7 using cumulative scores. Based on this classification, 41 students were categorized as at-risk and 58 as not at-risk.

Demographic data such as age, gender, school background, or programme enrolment were not available in the institutional dataset used for this study. The At-Risk reporting system at NUS records only academic variables (assessment scores, attendance flags, and assessment completion), which limits the ability to describe the sample in demographic terms. As such, the analysis focuses on performance-based indicators rather than demographic predictors. This reflects the structure of routine academic records at the institution and aligns with the study's purpose of evaluating outcome patterns rather than demographic disparities.

Table 1: Summary of Assessments Contributing to At-Risk Identification.

Assessment	Week Administered	Weight (%)	Description
Assignment 1	Week 1 – 3	4	Take-home written assignment
Test 1	Week 4	12	In-class test covering Week 1 – week 4
Test 2	Week 7	12	In-class test covering Week 4 – Week 7

Identification and Data Collection

The decision pathway for identifying at-risk students based on cumulative coursework performance is illustrated in Figure 3, highlighting the progression from assessment to classification.Data used in this study were obtained from routine academic records generated as part of standard course delivery. No additional data collection beyond the normal assessment process was required. All assessment activities were aligned with the course learning outcomes and were administered under standardized conditions. Since
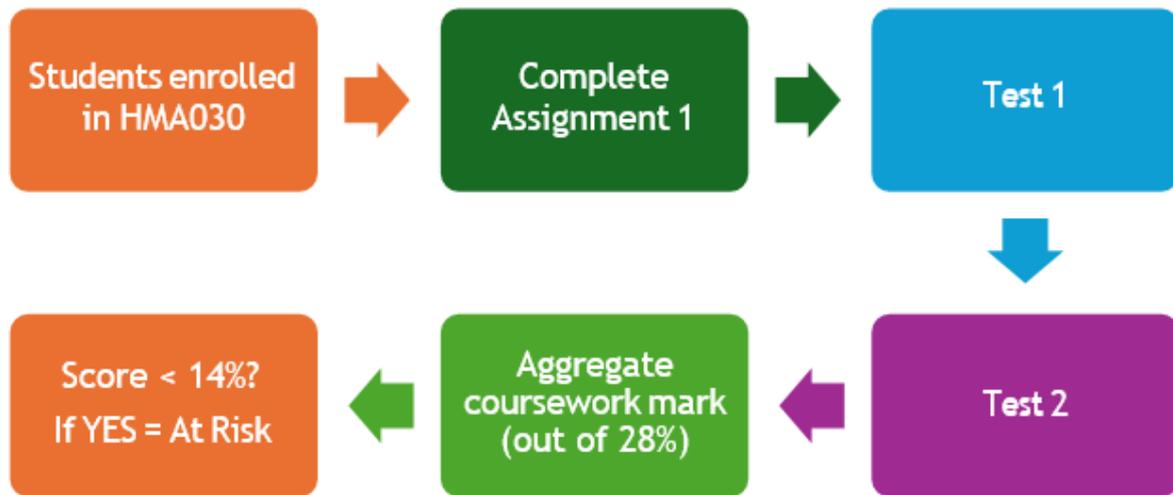
Figure 3: At-Risk Identification Process.

The study utilized anonymized, pre-existing data without any direct interaction with students or deviation from course procedures, no formal ethical approval was required.

Data Analysis

The data were analyzed using Microsoft Excel. Initial analysis involved descriptive statistics to summarize student performance and to categorize final outcomes (pass, fail, dropout). Correlation analysis and linear regression were used to explore relationships between students' performance in early coursework and their final course outcomes. R- squared values were calculated to measure the strength of predictive relationships. Prior to inferential testing, coursework scores were standardized for comparability across assessments.

All coursework assessments underwent routine internal moderation by the Foundation Programme Committee to ensure content validity, alignment with course outcomes, and consistency across markers. Items for Tests 1 and 2 were reviewed for clarity and cognitive level, and the grading rubric was pilot-tested on a small subset of anonymised scripts prior to full marking.

The study complied with institutional expectations for the use of routine academic data. All datasets were de-identified, stored in password-protected files, and accessible only to the course coordinator.

Table 2 Assessment Checkpoints and Performance Indicators Used in the At-Risk Protocol.

Checkpoint	Description	Purpose in At-Risk Process
Week 7 Assessment	First major test in the course covering foundational algebra, number operations, and problem-solving.	Identifies early gaps in conceptual understanding; primary trigger for At-Risk classification.
Week 14 Assessment	Second major test covering later course topics (functions, graphs, rates, and applied problems).	Measures academic recovery after feedback and intervention; indicates re-engagement.
Final Examination	Comprehensive cumulative exam assessing full course outcomes.	Determines final academic performance; used to evaluate long-term impact of early intervention.

Because the conceptual model centres on early detection and later recovery, the methodology operationalises this through three formal assessment checkpoints.

Table 2 summarizes the three performance checkpoints (Week 7, Week 14, and the Final Exam) used in the statistical analysis to track academic progress and evaluate the impact of the mid-semester intervention.

Limitations

This methodology presents several limitations. First, as Assignment 1 was a take-home task, there is a risk that some students may have engaged in plagiarism, potentially inflating or distorting early academic indicators. Second, the study focuses exclusively on the first seven weeks of the course, which may not fully capture students' later academic improvement or decline. Third, the analysis is confined to a single cohort within one course at a single institution, limiting generalizability beyond the immediate context.

The absence of demographic data (such as gender, age, or school background) represents a significant limitation, as these variables are known to influence academic performance. Because the institutional At-Risk dataset captures only academic indicators, this analysis was not possible. Furthermore, non-academic variables, such as variation in study time, home responsibilities, motivation, or access to digital tools; were not captured in institutional datasets. These unmeasured confounders limit the ability to fully isolate the effects of the

formative assessment intervention and are particularly relevant to academic recovery in Pacific higher education.

In addition to these data gaps, the dataset contained instances of incomplete academic records due to student absences, late withdrawals, or non-submission of assessments[9]. These were managed through listwise deletion so that each analysis included only students with complete data for the relevant checkpoint. While this approach maintains analytic clarity, it may underrepresent students who are disengaged most severely.

Nonetheless, the study aims to enhance internal validity and reliability by using consistent grading rubrics and assessment formats, as well as by applying a standardized threshold for identifying at-risk students. By focusing on established coursework performance data and widely used statistical techniques, the methodology provides a replicable approach to evaluating formative assessment and intervention strategies in similar educational contexts.

Ethical and Bias Considerations

De-identified, routine course data were used under standard institutional practice, with no deviation from normal teaching. Potential biases include instructor expectancy effects and unequal access to study time or devices. To mitigate these, we applied consistent rubrics across assessments, standardized score scales prior to modelling, and reported results disaggregated by risk status16. Future work will triangulate with qualitative interviews and LMS traces.

Recommendations for Institutional Data Reform

Future institutional reporting systems should integrate demographic, motivational, and non-academic indicators alongside assessment data. Doing so would enable more nuanced modelling of equity, risk factors, and intervention effectiveness, and would strengthen early-warning mechanisms across Pacific higher education contexts.

Future reporting systems should integrate demographic, motivational, and non-academic indicators alongside assessment data. Doing so would enable more precise modelling of equity gaps, risk patterns, and intervention effectiveness, and would strengthen early-warning mechanisms across Pacific higher education.

ANALYSIS OF STUDENT PERFORMANCE

Introduction

The following section presents results across the three assessment checkpoints described in

Table 2, highlighting performance patterns among students classified as At- Risk.

This chapter presents the quantitative analysis of student performance across three checkpoints: Week 7, Week 14, and the Final Exam. The aim was to determine whether the mid-semester intervention, centered on formative assessment and personalized feedback, had a measurable effect on at-risk students' academic outcomes. Data were drawn from 99 enrolled students (41 classified as at-risk at Week 7; 58 not-at-risk). The analysis employed descriptive statistics, Pearson correlation, and simple linear regression to evaluate the strength of associations between performance stages.

Week 7 vs. Week 14 Performance

The first comparison examined changes in student performance from Week 7 to Week 14. Descriptive data showed that most students improved after the intervention, with a visible shift in the middle-achieving group. However, the magnitude of improvement varied widely.

A Pearson correlation yielded an R-value of 0.51 ($R^2 = 0.26$, $p < 0.001$), indicating a moderate and statistically significant relationship between Week 7 and Week 14 scores. While these results suggest that earlier performance was somewhat predictive of mid-semester recovery, the moderate strength implies that other factors, such as student effort, tutorial attendance, or engagement with feedback; may have played a role in shaping outcomes.
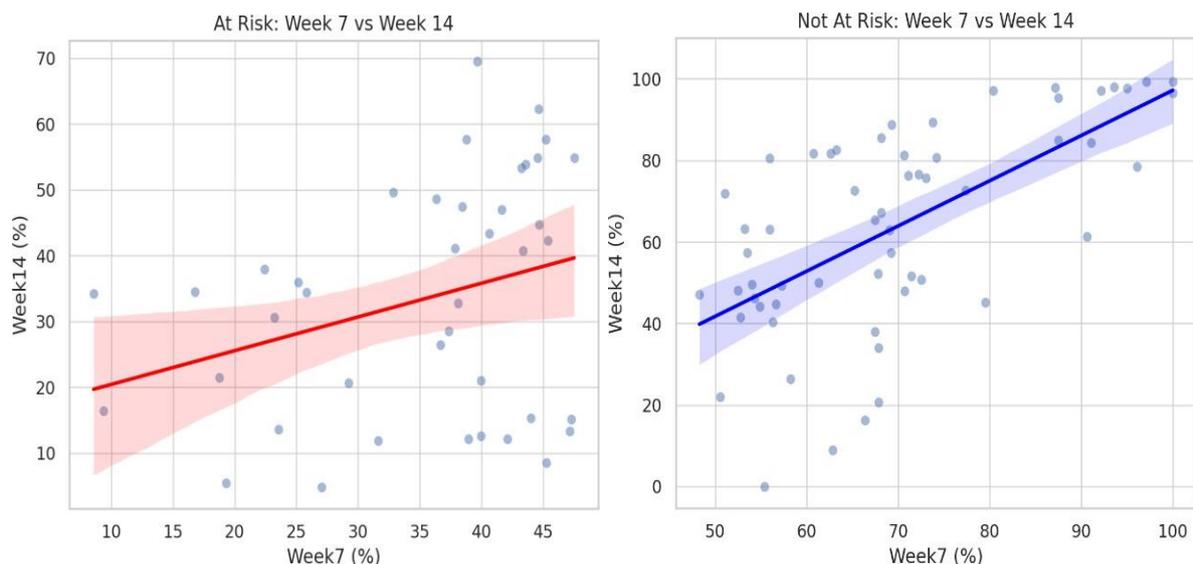

Figure 4 Regression comparison of Week 7 and Week 14 scores by risk status.

Figure Note.

This comparison shows a moderate predictive relationship (R² = .26) between early-semester performance and mid-semester improvement. The weaker trajectory among at-risk learners highlights the importance of guided feedback and structured learning opportunities beyond Week 7, indicating that early identification alone is insufficient without sustained academic and emotional support.

Figure 4 illustrates the relationship between early coursework and mid-semester performance for both At-Risk (top) and Not-At-Risk (bottom) students. While improvement occurred, the moderate correlations suggest that Week 7's performance only partially explains Week 14's outcomes. This reinforces findings from Cassells (2018), who emphasizes that one-time interventions are insufficient and must be followed by sustained support and student engagement. These results suggest that mid-semester gains depend on students' engagement with feedback activities rather than prior achievement alone, indicating the formative intervention's developmental value.

Implications for Teaching and Intervention

This result indicates that early performance gaps can still be reduced when learners receive timely, diagnostic feedback and structured opportunities to reattempt tasks. For lecturers, this reinforces the need to intervene before mid-semester rather than waiting for end-of-course failures. These patterns reflect the conceptual model's emphasis on early detection and confirm Cassells (2018) that mid-semester tutoring and feedback can shift trajectories for underprepared learners.

Week 14 vs. Final Exam Performance

The strongest relationship was observed between Week 14 and Final Exam results. Linear regression revealed an R-value of 0.51 ($R^2 = 0.26$, $p \leq 0.001$), showing that Week 14 performance was a moderately strong predictor of Final Exam success.

Students who improved by Week 14 were significantly more likely to perform well in the Final Exam, suggesting that the intervention's most meaningful impact occurred in the second half of the semester. The consistency between these two checkpoints supports the view that formative assessment and timely support, when acted upon, can positively influence long-term outcomes. The parallel between Week 14 and Final outcomes
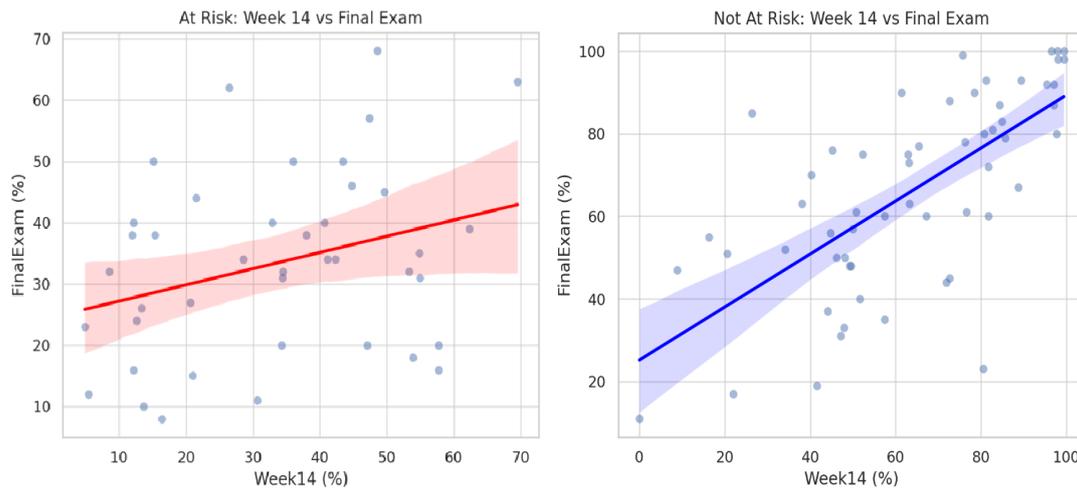
Figure 5 Regression comparison of Week 14 and Final Exam scores.

Confirms that consistent engagement post-intervention consolidates learning; students who re-entered feedback loops sustained their improvement.

Figure Note.

The relationship between Week 14 and Final Exam scores is stronger than the earlier checkpoints, suggesting that formative feedback and engagement during the second half of the semester are critical drivers of academic recovery. Educators should prioritize structured follow-ups after Week 14 to consolidate learning and promote exam readiness.

Implications for Teaching and Intervention

The moderate relationship between Week 14 and Final Exam scores suggests that learners who re-engage after feedback are most likely to benefit from late-semester revision opportunities. This underscores the value of sustained academic and emotional support throughout the semester, not only at initial checkpoints. The finding aligns with resilience theory, which argues that improvement depends on both academic guidance and affective engagement (Kahu, 2013; Benard, 2004).

Week 7 vs. Final Exam Performance

The final set of analyses explores the long-term relationship between early semester performance and final exam results. This relationship is of particular importance, as it informs us of the usefulness of Week 7 as a diagnostic checkpoint.

The overall Pearson correlation between Week 7 and Final Exam scores was r = 0.80, with an R^2 value of 0.63 ($p < .001$), indicating a strong and statistically significant linear relationship. This means that early coursework performance explains approximately 63% of the variation in

Final Exam scores across all students.

However, when disaggregated, the relationship was stronger for Not-At-Risk students (R²
≈ 0.66) than for At-Risk students (R² ≈ 0.42), showing that predictive reliability is reduced
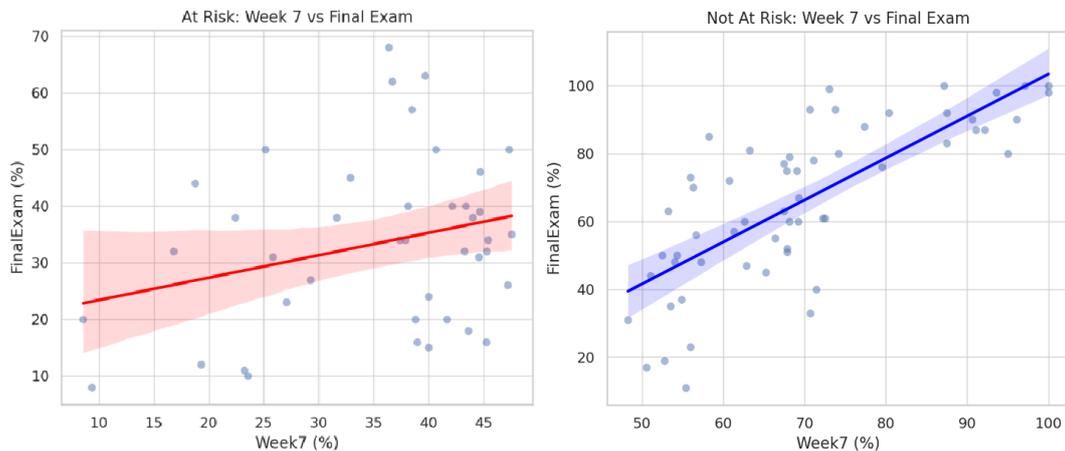among students already struggling.

Figure 6 Regression comparison of Week 7 and Final Exam scores.

Figure Note.

The strong predictive relationship overall (R² = .63) confirms the diagnostic value of early coursework; however, significantly lower predictability for at-risk students (R² ≈ .42) reveals that emotional, contextual, and motivational barriers disrupt straightforward academic progression. This underscores the need for holistic intervention models that pair academic feedback with relational and institutional support.

This figure highlights the predictive strength of early coursework performance on final exam outcomes for At-Risk and Not-At-Risk students. These results align with Mirza and Arif (2018), who argue that one-time feedback or generalized support is insufficient for meaningful academic gains in vulnerable students.

Instead, they advocate for ongoing, multifaceted interventions; including mentoring, emotional support, and differentiated instruction; that help students persist through academic challenges. Early performance remains the strongest predictor overall, but reduced predictive strength among at-risk students signals that emotional and contextual barriers attenuate the effect of formative assessment.

Implications for Teaching and Intervention

The strong relationship between early coursework and final outcomes highlights the urgency of intervening during the first month of the semester. Students who fall behind early have limited time to recover, especially in a cumulative subject such as mathematics. This supports shifting the At-Risk checkpoint toward Week 4–5 and reinforces the model's view that timely feedback, relational care, and structured revision are essential for enabling academic recovery.

Summary of Key Findings

• Most students improved between Week 7 and Week 14, though gains were inconsistent.

• The correlation between Week 14 and Final Exam was stronger than any other pairing, suggesting that later performance more accurately predicts final outcomes.

• Week 7 results alone were not sufficient to determine final success, highlighting the value of formative feedback and continued support beyond early intervention.

• While the intervention was beneficial for some, its effects were not uniform, underscoring the need for more personalized and holistic support systems.

Key findings with respect to the research questions.

RQ1: At-risk students who engaged with feedback between Week 7 and Week 14 showed meaningful, but uneven, gains by Final; the Week 14 → Final link was moderate (r = .51, R^2 = .26, p < .001).

RQ2: Week 7 strongly predicted Final overall (r = .80, R^2 = .63), but predictive strength dropped among at-risk learners (R^2 ≈ .42), indicating vulnerability moderates straightforward prediction.

RQ3: Findings support earlier risk checkpoints, explicit feedback-literacy activities, and coordinated tutorial/counselling support to sustain recovery beyond Week 14.

DISCUSSION AND RECOMMENDATIONS

Discussion of Results

The findings from this study indicate that formative assessment can play a significant role in improving the academic outcomes of at-risk students; but only when embedded within a broader framework of sustained engagement, relational support, and timely feedback. The moderate correlation between Week 14 and Final Exam scores (R^2 = 0.26, p < 0.001) suggests that students who engaged meaningfully with mid-semester feedback were more likely to

recover and succeed.

However, performance gains were inconsistent, with some students showing limited or no improvement despite participating in the intervention. Several factors may explain this variation:

- **Feedback literacy**: Some students may have lacked the skills or confidence to understand and apply feedback effectively.

- **Study environment**: Others may have faced home-based distractions or obligations that limited their capacity to revise.

- **Emotional disengagement**: For students who internalized early failure, self-doubt may have overridden the effects of feedback.

These findings affirm that formative assessment is necessary but not sufficient. Without additional supports; academic, emotional, relational; it is unlikely to produce consistent results across all at-risk students.

Integrating Findings with Literature

These results align closely with Pacific and global literature on formative assessment. Cassells (2018) has shown that structured feedback boosts outcomes only when students are supported to re-engage, which explains the uneven gains among at-risk learners. Similarly, Kahu's (2013) model clarifies why emotional engagement mediates performance; students who internalized early failure showed weaker alignment between Week 7 and Week 14, reflecting the affective barriers identified in the literature. This study therefore reinforces the consensus that formative assessment must be embedded within broader systems of relational and institutional support, not implemented as a stand-alone practice.

The study reinforces global evidence that formative assessment enhances achievement (Black & Wiliam, 1998; Wiliam, 2011) while extending resilience theory into a Pacific frame that values cultural respect and relational pedagogy. Variability in outcomes echoes Mirza and Arif (2018) and Kahu (2013), confirming that engagement quality mediates intervention impact.

Recent international studies similarly emphasize that resilience-building practices are essential for supporting vulnerable learners, particularly during periods of academic or personal disruption (Awais et al., 2024).

This aligns with emerging work on higher-education transformation in small-island settings, which highlights the need for context-responsive curricula and student support systems

tailored to local cultural and structural realities (Telesford et al., 2024).

Mechanism and Transferability Summary: What Worked, Why, and For Whom

What Worked

- Early detection using Week 7 results and behavioural indicators.

- Targeted formative feedback linked to students' specific error patterns.

- Structured opportunities to reattempt problems between Weeks 7 and 14.

- Relational support through culturally aligned, non-confrontational communication.

Why It Worked

- Week 7 scores strongly predicted final outcomes, highlighting the need for early intervention.

- Feedback literacy, written guidance, and repeated attempts helped students rebuild conceptual understanding.

- Resilience and persistence increased when students felt supported and believed improvement was possible (Benard, 2004; Kahu, 2013).

- Students' engagement improved when communication matched Pacific cultural norms (Lee Hang & Bell, 2015).

For Whom It Worked

- Students who re-engaged with feedback and attended tutorials showed the greatest improvement (Week 14 → Final patterns).

- Students with stable study environments, fewer home obligations, or greater emotional support benefited most.

- Students who disengaged early or faced structural obstacles (e.g., digital access, time constraints) showed limited recovery.

Transferability

- The protocol is well-suited to small-island and low-resource institutions.

- Can be adapted to other cumulative subjects (Physics, Accounting, Economics).

- Works best when paired with simple digital tracking and culturally attuned communication strategies.

Recommendations

For Lecturers

- **Shift the At-Risk checkpoint to Week 4–5**, because the results from Week 7 vs Final (Section 4.4) demonstrate that early performance predicts final outcomes strongly. Intervening earlier gives struggling learners enough time to recover.

- **Provide feedback-literacy mini-tasks** (e.g., how to interpret comments, how to plan a revision strategy). This aligns with evidence that students often receive feedback but do not know how to use it (Carless & Boud, 2018).

- **Use diagnostic "error-pattern" tasks derived from earlier assessments**. Findings from 4.2 confirm that targeted practice between Week 7 and Week 14 supports moderate improvement among re-engaged students.

- **Document progress through short reflective journals**, reinforcing metacognitive engagement, which is a key protective factor in resilience theory (Benard, 2004).

These recommendations directly reflect patterns observed in Sections 4.2–4.4, where students who engaged with targeted feedback demonstrated the clearest academic recovery.

For Institutions

- **Integrate academic and well-being tracking systems**, because analysis shows that emotional engagement influences academic recovery (Week 14 → Final). Resilience literature and your findings emphasise the need to monitor both academic and affective factors.

- **Formalise referral protocols** for students who show repeated non-submission. This addresses the missing-data pattern noted in Methodology and supports early re-engagement.

- **Resource PD training for formative feedback and culturally aligned communication**, strengthened by Pacific literature (Lee Hang & Bell, 2015) and the uneven effect of feedback seen in at-risk learners.

- **Develop a timetable structure that protects tutorial time for targeted intervention**, since your results show meaningful gains only when students have space to apply feedback (Section 4.2 and 4.3).

Institution-level action is supported by both the quantitative findings and resilience literature, which together show that structural and relational support systems are critical for sustaining learner improvement.

For Policymakers

- **Embed early-warning systems in sector standards**. This is supported by strong early-predictor findings in your dataset and echoes global evidence (Milne et al., 2012; Herodotou et al., 2019).

- **Fund resilience-building initiatives** linking secondary-tertiary transitions, because the study confirms that emotional engagement and structural constraints shape outcomes.

- **Support digital-resource infrastructure across schools and universities**, as digital access emerged as a confounder influencing students' capacity to revise or seek help.

- **Prioritise data systems that capture non-academic variables**, enabling holistic tracking of risk patterns that currently cannot be analysed (e.g., family obligations, study time, motivation).

Policy-level reform is essential to scale the improvements observed in this study, ensuring that resilience-building approaches are embedded across the wider Pacific education sector.

CONCLUSION

This study explored the effectiveness of formative assessment as an intervention tool for supporting at-risk students enrolled in the HMA030 Foundation Mathematics course at the National University of Samoa during the 2023 academic year. Grounded in resilience theory, the research focused on how early identification, targeted feedback, and structured academic support influenced student performance across three checkpoints: Week 7, Week 14, and the Final Exam.

The analysis revealed a moderately strong correlation between Week 14 and Final Exam scores ($R^2 = 0.26$, $p < 0.001$), suggesting that students who engaged with feedback and support in the second half of the semester were more likely to succeed. However, performance gains were not consistent across all students, pointing to the limitations of formative assessment when delivered in isolation. The findings affirm that academic recovery for at-risk learners is shaped not only by access to feedback, but also by emotional engagement, study conditions, and the ability to act on guidance.

This study adds Pacific-specific evidence that resilience-informed formative assessment can enable academic recovery when paired with timely identification, explicit guidance on using feedback, and relational support. Beyond confirming well-known benefits of formative assessment, we show how cultural communication preferences and structural constraints

moderate its impact for at-risk learners.

Overall, the results affirm that resilience-oriented formative assessment is not simply beneficial, but essential for supporting underprepared learners in Pacific higher education. By implementing earlier checkpoints, structured feedback cycles, and relational support systems, institutions can substantially improve academic recovery and retention. Resilience-informed formative assessment must become a core expectation of mathematics teaching and institutional policy in small-state and under-resourced systems worldwide, ensuring that all learners, not only the most prepared, have a fair pathway to succeed.

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