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No student left behind: Scaling equity and belonging in first-year mathematics

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ABSTRACT

This paper describes a three-year institutional journey to enhance equity, engagement, and belonging in first-year calculus and foundational mathematics courses for Economics and Management students at Nova School of Business and Economics (Nova SBE). The initiative emerged in response to growing diversity among incoming students, who arrive from a wide range of national and international educational systems with varying levels of mathematical preparation. Over time, differences in readiness had translated into persistent achievement gaps and lower confidence among specific student groups, particularly those from under-represented backgrounds.

The project unfolded in three iterative phases. The first, *Bridging the Gap* (2023/24), introduced instructor-led learning modules, each including a self-paced online quiz, aimed at consolidating core mathematical skills. Data analysis showed that student engagement, measured by quiz attempts, strongly predicted achievement, yet participation was lowest among those most in need of support. The second phase, *Closing Equity Gaps* (2024/25), implemented a diagnostic assessment that enabled early identification of underprepared students and targeted support through structured workshops. This intervention reduced performance disparities and increased students' self-efficacy. The current phase, *No Student Left Behind* (2025/26), expands the approach into a holistic model that integrates diagnostics, active learning, peer mentoring, and community-building to foster belonging and confidence.

Across all phases, findings suggest that equity in mathematics may be strengthened through proactive, data-informed, and compassionate pedagogy. The project shows how early assessment, structured support, and relational engagement can transform mathematics from a barrier into a shared academic journey, ensuring that every student can succeed.

Keywords: first-year experience; equity and diversity; inclusive excellence; belonging; engagement; self-regulated learning; higher education

Introduction

Across the world, higher education institutions are welcoming increasingly diverse cohorts of first-year students, a change that brings both opportunity and complexity. At Nova School of Business and Economics (Nova SBE), this diversity is particularly evident in mathematics-based courses, where students come from a wide range of educational systems and curricula. Within a single classroom, it is now common to find students who have completed the Portuguese national curriculum alongside those who studied under international programmes such as A-levels, the International Baccalaureate, or curricula from Portuguese-speaking African countries (PALOP). This heterogeneity enriches classroom discussion and perspectives but also produces pronounced disparities in mathematical readiness and confidence.

Moreover, many international students, particularly those from PALOP countries, face delays in starting their academic year due to visa-related issues. This often results in them missing the crucial first weeks of classes, which significantly exacerbates the challenges they already encounter in succeeding in mathematics courses. The initial weeks are essential for establishing foundational concepts and adapting to the academic environment, and missing this period can hinder their ability to keep pace with the curriculum, ultimately impacting their performance and confidence.

Research on the first-year experience consistently shows that the transition from secondary to higher education is critical for academic persistence and sense of belonging (Kift et al., 2010; Tinto, 2012). For many students, mathematics functions as a "gatekeeper subject", shaping not only academic success but also identity as a capable learner (Rylands & Shearman, 2018). Unequal prior preparation can therefore undermine engagement, exacerbate anxiety, and widen achievement gaps, particularly among students from less-resourced educational backgrounds (OECD, 2021). Tomlinson and Killingback (2025) emphasise that the early weeks of university are pivotal for building confidence and belonging, as both students and lecturers renegotiate expectations and identities in the new learning environment. This insight reinforces our own findings that missing the initial classes or lacking early support significantly amplifies students' challenges in mathematics.

The literature on student engagement highlights that belonging and connection are as influential as ability in predicting retention and success (Kahu & Nelson, 2018; Thomas, 2012). In this context, the implementation of targeted support strategies for students experiencing similar academic challenges, such as learning circles and peer tutoring, proves to be particularly impactful. These initiatives not only provide academic scaffolding but also foster meaningful relationships among students, helping them feel part of the institution and integrated into a supportive learning community. By promoting collaboration, shared responsibility, and mutual encouragement, such measures enhance students' sense of belonging, which is a key driver of motivation, persistence, and overall academic achievement.

In this context, mathematics educators face a dual responsibility: to ensure conceptual mastery and to create conditions in which all students can succeed. The project described in this paper emerged from that dual imperative. Over the past three academic years, we have progressively developed and refined a structured, data-informed approach to fostering equity, engagement, and belonging in first-year mathematics. The journey, spanning *Bridging the Gap* (2023/24), *Closing Equity Gaps* (2024/25), and *No Student Left Behind* (2025/26), illustrates how sustained pedagogical innovation can transform early learning experiences for increasingly diverse cohorts.

Towards an equitable mathematics pathway

At Nova SBE, mathematics forms the cornerstone of all undergraduate programmes, including Economics and Management. However, the first-year experience in mathematics has increasingly reflected the growing diversity of our student population. Over the past decade, Nova SBE has become an international learning community, welcoming students from the Portuguese national system, PALOP countries, and a range of international curricula. These students arrive with differing levels not only of mathematical fluency, symbolic familiarity, and problem-solving experience, but also of work habits and study methods.

Institutional data consistently indicated that students from the Portuguese system achieved higher pass rates and averages in Calculus and Linear Algebra. In contrast, students from international backgrounds were more likely to struggle, withdraw, or repeat. Similar disparities in mathematical transition have been

observed internationally and are often linked to differences in curricular coverage, language, and prior exposure to symbolic reasoning (Di Martino et al., 2022).

The implications of these gaps go beyond cognitive readiness. Research in educational psychology shows that self-efficacy (a learner's belief in their ability to succeed) is one of the strongest predictors of persistence and achievement in mathematics (Bandura, 1997). Students who begin their studies feeling underprepared are more likely to disengage, even when they have the potential to succeed (Rylands & Shearman, 2018).

Recognising this, our approach to first-year mathematics has evolved from a traditional content-driven model toward a framework grounded in inclusive excellence (Thomas, 2012). Rather than viewing diversity as a deficit, we see it as an invitation to redesign learning environments that empower all students to thrive. The interventions described in the following sections were developed precisely with this purpose: to create equitable entry points into mathematics and to ensure that no student is left behind.

Implementation of the project

The development of the *No Student Left Behind* initiative unfolded through a three-phase, iterative process of design, reflection, and evidence-informed refinement. Each phase responded to lessons learned from the previous one and progressively broadened the project's scope: from individual skill reinforcement to systemic equity and belonging.

The implementation approach was guided by three principles:

1. Data-informed practice, ensuring that interventions were grounded in evidence of student performance and engagement.
2. Pedagogical inclusiveness, focusing on scaffolding rather than remediation, and fostering a growth mindset in mathematics learning.
3. Community and belonging promotion, through collaboration among students and shared responsibility between learners, faculty, and mentors.

The first phase (*Bridging the Gap*, 2023/24) focused on providing foundational learning opportunities through instructor-led learning modules and self-paced online quizzes. The second (*Closing Equity Gaps*, 2024/25) introduced a diagnostic component to identify and support underprepared students early in the semester. The third (*No Student Left Behind*, 2025/26) expanded the initiative into an integrated learning ecosystem combining assessment, peer mentoring, and community engagement.

Together, these three phases form a coherent trajectory of institutional learning: moving from awareness of inequities to their intentional reduction, and ultimately toward the cultivation of a culture where all students, regardless of background, are supported to thrive in mathematics.

Bridging the Gap (2023/24): Engagement as an equaliser

The *Bridging the Gap* initiative, launched in 2023/2024, was the first institutional step toward addressing the equity challenge in first-year mathematics. Its goal was to provide all incoming students with a structured opportunity to revise and consolidate fundamental mathematical concepts before they would be needed in Calculus I classes, in the first semester of their studies.

The intervention consisted of ten instructor-led learning modules, covering foundational topics such as algebraic manipulation, basic functions, limits, and derivatives, each granting a one-tenth-of-a-point bonus in Calculus I final grade upon successful completion. Each module included an online self-assessment quiz, which required a minimum grade of 14 and allowed a maximum of two attempts.

Analysis of data from over 650 students revealed strong patterns. Students from the General Contingent (Portuguese curriculum) were the most engaged, averaging approximately ten total attempts and achieving a mean final grade of 11.6 (out of 20) in Calculus I, while PALOP and International students averaged fewer than six total attempts and had mean final grades below 7 (Figure 1). Students entering through the CEsp pathway, which includes candidates admitted via special access routes such as change of programme or school, athletes, mature students (aged 23 or older), and family members of diplomates, displayed intermediate results, with average final grades around 8–9, suggesting moderate levels of engagement and performance relative to the other groups. The extra points awarded followed the same pattern (Figure 2).

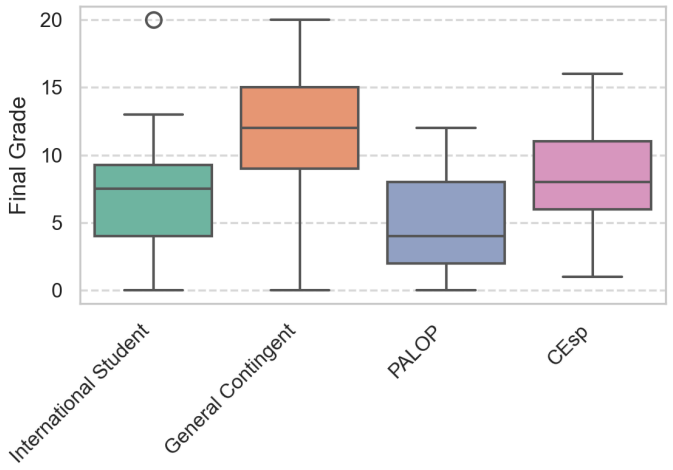

Figure 1 Final grade distribution by student type (2023/24)

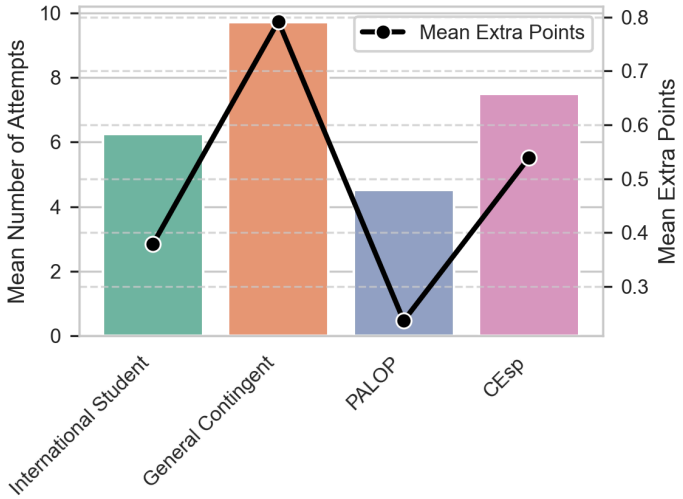

Figure 2 Mean number of attempts and extra points by student type (2023/24)

Moreover, the relationship between total quiz attempts and final grade was positive and linear (r = 0.35, p-value < 0.001), confirming that engagement predicted success (Figure 3). Students who completed and reattempted most quizzes achieved final grades above 11, while those who made fewer than five attempts averaged below 7.

This evidence demonstrates that effort and persistence, not prior curriculum, best explain academic success. It aligns with existing research showing that formative feedback and self-regulated learning are central to achievement (Nicol & Macfarlane-Dick, 2006; Zimmerman, 2002). In fact, Sewell (2025) argues that formative assessment achieves its transformative potential only when students understand and act upon feedback within their own disciplinary context. This resonates with our approach to embedding low-stakes quizzes and targeted workshops as tools for developing feedback literacy and self-regulated learning in mathematics. Consistent with Sewell's framework, our data show that students who repeatedly engaged with feedback opportunities achieved the greatest performance gains (Figure 3).

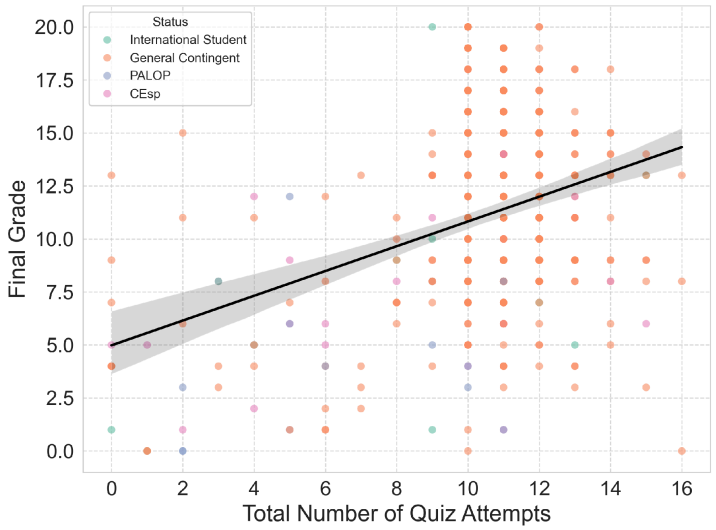

Figure 3 Relationship between total quiz attempts and final grade (2023/24)

Closing Equity Gaps (2024/25): The power of early identification

In 2024/2025, *Closing Equity Gaps* introduced a Baseline Assessment Test designed to measure students' mathematical readiness at the start of term. The diagnostic revealed substantial variation in prior knowledge (Figure 4), with students scoring below 14/20 identified as at-risk and invited to attend mathematics support sessions.

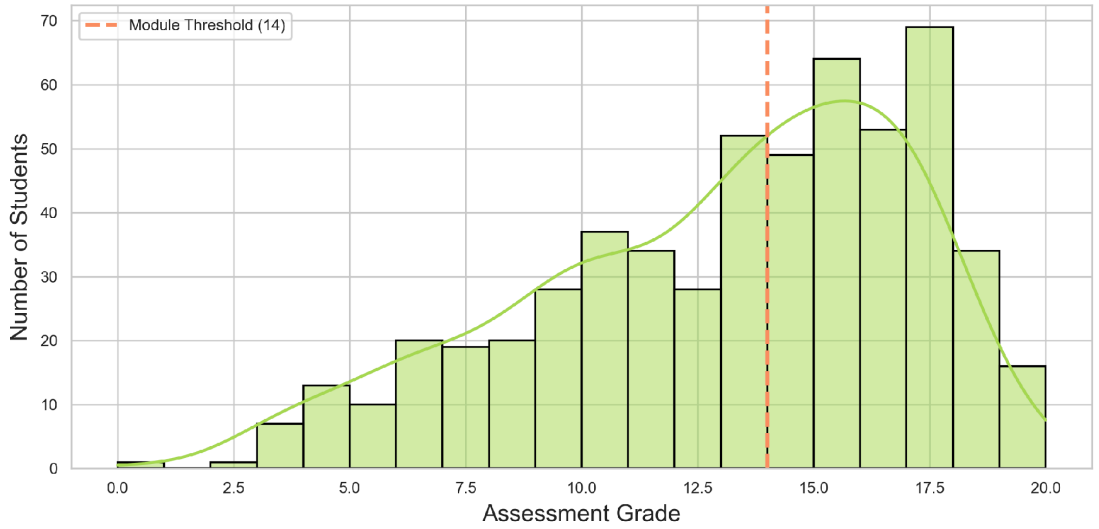

Figure 4 Baseline Assessment Test results by score group (2024/25)

Results were striking. As shown in Figure 5, about 49% of the students were strongly advised, based on diagnostic results, to study the week's foundational topic, complete quizzes, and attend workshops where appropriate. While participation was not mandatory, targeted communication from faculty emphasised the importance of engagement. Students who invested in the preparation of the foundational topics and participated in the workshops achieved significantly higher exam performance than those who did not. A Mann–Whitney U test confirmed that this difference was statistically significant ($U = 9995.0$, $p < .001$). The final grade distributions (Figure 6) show a clear narrowing of the performance gap between the two groups identified by the Diagnostic Test ($U = 61612.0$, $p < .001$).

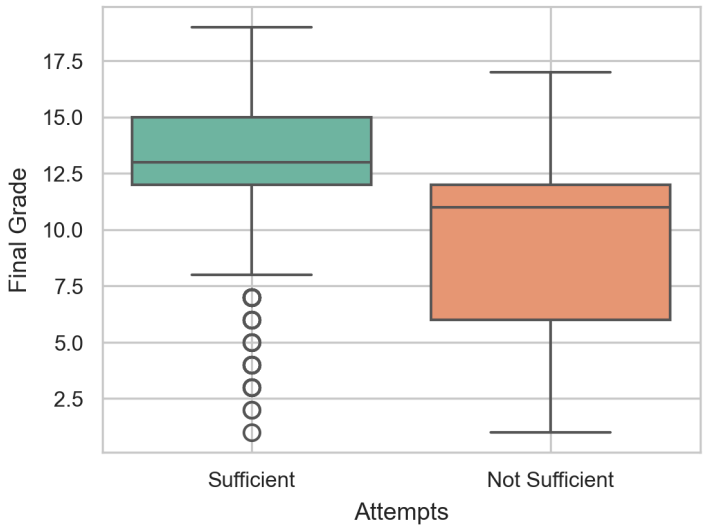

Figure 5 Comparison of final grades between students who invested in the preparation of the foundational topics and those who did not (2024/25)

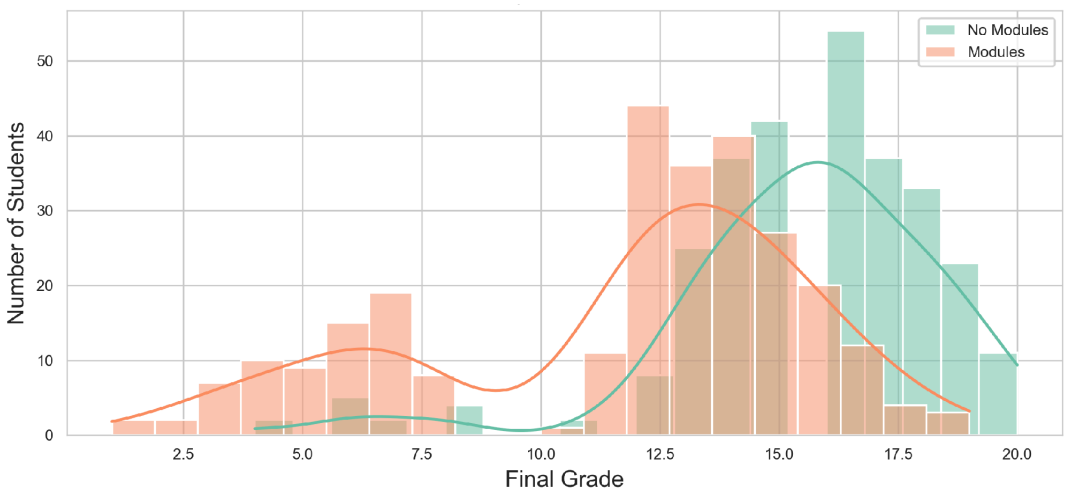

Figure 6 Final grade distribution by student status (2024/25)

Additionally, the relationship between total module attempts and final exam grade remained significant ($r = 0.26$, $p < .001$) (Figure 7). This confirmed that continued engagement through self-directed practice and support sessions predicted success across all backgrounds.

Together, these findings highlight that early identification, feedback, and structured engagement can mitigate disparities and empower students to take ownership of their learning (Crisp, 2012; Carless & Boud, 2018).

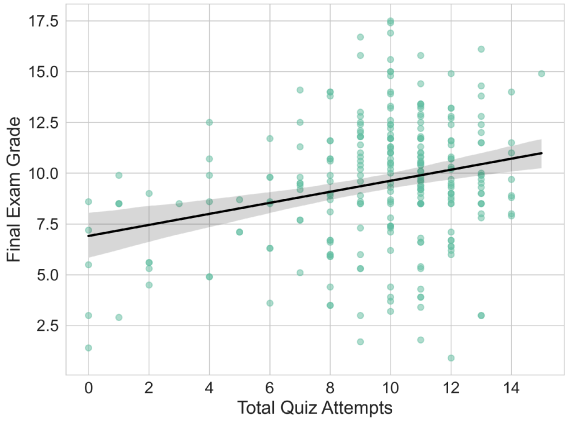

Figure 7 Relationship between total quiz attempts and final exam grade (2024/25)

No Student Left Behind (2025/26): From support to belonging

The current phase, *No Student Left Behind: Succeeding Together in First-Year Mathematics*, builds on these lessons to foster a stronger sense of belonging. The model integrates four interconnected components: Diagnostic Assessment, Mathematics Workshops, Resource Hub & Faculty Nudges and Learning Circles & Peer Tutoring (Figure 8).

Preliminary data indicate participation rates above 90% in the baseline diagnostic and a doubling of workshop attendance compared to the previous year. Student feedback highlights that the programme

"makes mathematics easier to grasp, facilitating understanding across other subjects," and "helps students gain confidence to succeed in more challenging courses, particularly calculus".

These results align with the broader literature linking peer connection and belonging to academic persistence (Thomas, 2012; Kahu & Nelson, 2018). Peer mentoring (Colvin & Ashman, 2010) and consistent faculty engagement have reframed help-seeking as a normal and valued learning behaviour.

Through *No Student Left Behind*, the initiative has evolved from an academic support mechanism into a learning community grounded in care, collaboration, and shared success.

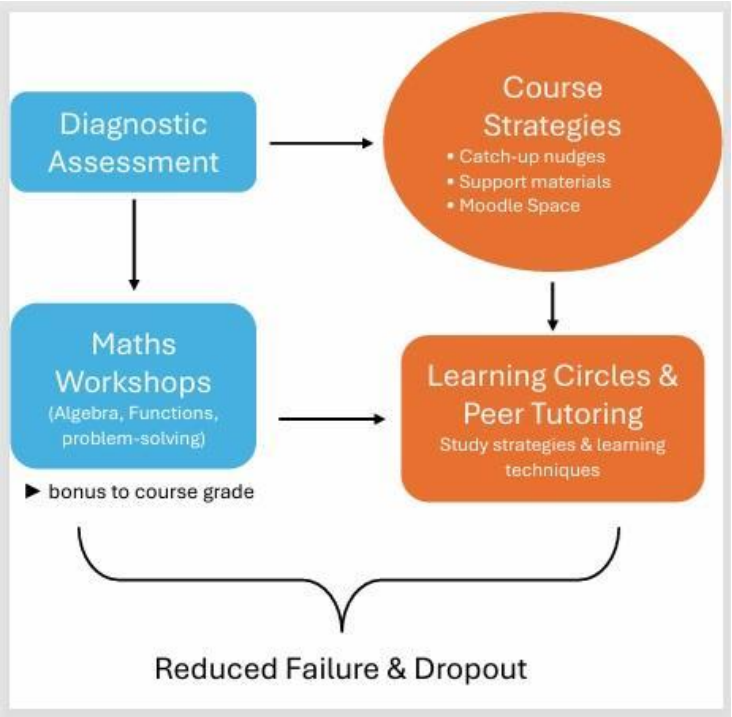

Figure 8 Framework of the four-component *No Student Left Behind* model (2025/26)

Student Voice and Engagement Mechanisms

Across the three phases of the initiative, participation rates and patterns of engagement improved steadily. While the availability of structured learning resources undoubtedly contributed to this shift, it would be overly simplistic to attribute engagement solely to resource provision. Multiple interacting mechanisms appear to have influenced participation, including affective reframing of mathematics, early diagnostic feedback, peer support structures, and explicit academic incentives.

Engagement with the preparatory modules and associated workshops was linked to a modest but visible grade incentive. Students who successfully completed the required quizzes and met the participation criteria could earn up to one additional point (out of 20) to be added to their final course grade. Participation in the diagnostic assessment was integrated into this framework, as the results determined eligibility for targeted preparation activities that contributed to the bonus system. The additional point was not intended to enable students to pass the course; it was applied only to those who had already achieved a passing grade at the end of the semester, allowing the final mark to increase by a maximum of one point.

Participation in the initiative remained voluntary, and no penalties were imposed for non-engagement. The incentive therefore functioned primarily as encouragement rather than as a coercive mechanism.

Student feedback, collected through course evaluations, workshop reflections, and informal comments, indicates that many participants perceived the initiative as reducing anxiety and increasing confidence. Students frequently described the programme as:

- "making mathematics easier to grasp,"
- "helping build confidence before exams,"
- "providing structure at the beginning of the semester,"
- "normalising that it's okay not to understand everything immediately."

These perceptions suggest that the intervention may have influenced affective dimensions of learning alongside cognitive preparation. In line with research on belonging and self-efficacy (Bandura, 1997; Thomas, 2012), students appeared to experience workshops and learning circles as psychologically safer spaces in which questions could be asked without stigma.

Importantly, many students did not describe participation primarily in terms of the bonus point. While the grade incentive likely reduced initial barriers to engagement, feedback suggests that students increasingly valued the programme for its perceived academic and emotional benefits. Nevertheless, it would be unrealistic to assume that the incentive played no role; for some students, particularly in the early phases, the possibility of gaining up to one additional point may have served as an important motivational catalyst.

The introduction of the Baseline Assessment Test in the second phase appears to have influenced engagement patterns by making expectations visible early in the semester. The diagnostic was intentionally framed as formative rather than evaluative. Students who scored below the threshold were invited to participate in additional structured preparation activities which, when completed successfully, contributed toward the potential bonus point.

This alignment between diagnostic feedback and tangible academic benefit may have strengthened students' responsiveness to the assessment. Rather than perceiving the test as merely informational, students could connect their results to actionable steps with clear academic value.

Several students reported that the diagnostic "helped identify what to revise" and "clarified what was expected." Such feedback suggests that the assessment may have enhanced students' sense of agency by providing structured pathways for improvement. This interpretation aligns with theories of self-regulated learning (Zimmerman, 2002) and feedback literacy (Carless & Boud, 2018).

However, it remains possible that students most responsive to the diagnostic, and most motivated by the incentive, were those already inclined toward proactive study behaviours. The data do not allow for definitive conclusions regarding the relative influence of intrinsic versus extrinsic motivation.

The bonus structure was deliberately designed to be meaningful without being determinative. While it could support modest grade improvement, it was not intended to compensate for insufficient performance in the core course assessments. This balance aimed to encourage preparation and engagement without compromising academic standards.

Although the incentive likely contributed to initial participation, engagement patterns observed in later phases—particularly in peer-led workshops and learning circles—suggest that participation gradually became less dependent on grade optimisation alone. Attendance increased even as activities became more

collaborative and less centred on quiz completion, indicating that relational and cultural factors may also have played an important role.

Sustainability and institutional embedding

While early evidence suggests positive engagement and performance trends, the long-term value of the *No Student Left Behind* initiative depends on its sustainability and degree of institutional integration. Educational interventions often demonstrate initial success when driven by motivated individuals or supported by pilot funding. However, they struggle to endure once novelty fades or leadership changes. For this reason, attention increasingly shifts from short-term outcomes toward questions of structural embedding and cultural continuity.

The first phase of the initiative, *Bridging the Gap*, emerged as a targeted response to observed achievement disparities in first-year mathematics. Initially, its implementation relied heavily on the commitment of a small group of faculty members who designed learning modules, analysed engagement data, and coordinated communication with students. As subsequent phases were introduced, however, the initiative gradually evolved from an instructor-led innovation into a more integrated programme-level strategy.

By the third phase, core elements, including the baseline diagnostic assessment, preparatory modules, and structured workshops, had been incorporated into the formal design of the Calculus I course. The diagnostic assessment is now scheduled within the academic calendar, and workshops are announced alongside standard course activities. This integration reduces reliance on ad hoc implementation and signals that preparatory engagement is an expected component of the course structure rather than an optional supplement.

Coordination among faculty teaching different sections of first-year mathematics has also increased. Shared materials, common communication templates, and collective discussion of engagement data have contributed to greater alignment across teaching teams. While leadership remains important, operational knowledge is no longer concentrated in a single individual.

Sustainability also depends on material and organisational support. Over the three-year period, the initiative has benefitted from institutional recognition, including the allocation of teaching hours for workshop facilitation. The role of peer mentoring activities is currently under evaluation by the school's leadership, with ongoing discussions on how these responsibilities might be formally integrated into faculty workload models. At the same time, the initiative remains resource-sensitive. Workshop delivery requires faculty or trained tutors; peer mentoring depends on the recruitment and coordination of student mentors; and ongoing data analysis requires time and expertise. As participation increases, logistical complexity also grows, and maintaining quality while expanding reach will require continued institutional commitment.

At present, the additional workload associated with workshops and diagnostic feedback has been absorbed within existing teaching allocations. While manageable at the current scale, long-term sustainability may depend on clearer recognition of these activities within workload models to avoid over-reliance on voluntary effort.

Beyond structural integration, sustainability is also influenced by cultural embedding. There are early indications that preparation for mathematics courses is becoming increasingly normalised within the student experience. The growing uptake of workshops and references to the initiative across student cohorts suggest that engagement may be gradually shifting from faculty-driven encouragement to peer-supported expectation.

If sustained, such norm formation could reduce the need for intensive promotional effort. When preparation activities are perceived as routine components of academic success, participation may become self-reinforcing. Nevertheless, this cultural embedding remains emergent rather than fully established. Changes in student cohorts, faculty rotation, or shifts in institutional priorities could disrupt continuity. Longitudinal monitoring will therefore be necessary to determine whether engagement patterns stabilise independently of active advocacy.

The *No Student Left Behind* model was developed within the specific context of first-year mathematics at Nova SBE, and its scalability to other quantitative courses, or to different disciplinary contexts, remains an open question. Certain elements, such as early diagnostic assessments and structured formative modules, may be transferable across disciplines. Others, particularly those dependent on peer mentoring cultures or close faculty collaboration, may require contextual adaptation. The initiative's development has also benefited from relatively contained cohort sizes and a cohesive teaching team; scaling the model to larger or more fragmented contexts may introduce additional coordination challenges.

Furthermore, while grade incentives have supported engagement, their long-term effectiveness warrants continued examination. If participation becomes primarily incentive-driven, there is a risk that intrinsic motivation may be overshadowed. Conversely, if engagement norms become culturally embedded, the relative importance of incentives may diminish over time.

The initiative aligns closely with institutional priorities related to first-year transition, retention, and inclusive excellence. Its emphasis on early identification, belonging, and structured academic support reflects broader principles of transition pedagogy (Kift et al., 2010). This alignment strengthens its prospects for continuity, positioning the initiative not as an isolated innovation but as part of a broader institutional effort to support diverse student cohorts.

Nevertheless, sustainability should not be assumed. The continued viability of the initiative will depend on its perceived value relative to other institutional priorities. In this sense, sustainability must be understood as both structural and cultural. Structurally, the initiative has evolved from a pilot project into an embedded course component with shared ownership. Culturally, there are emerging signs that engagement with mathematics support is becoming normalised within the student community.

These developments remain in progress. Ongoing evaluation, transparent workload recognition, and continued alignment with institutional strategy will be essential to ensure that *No Student Left Behind* remains more than a time-bound innovation. Ultimately, sustainability is not only about maintaining activities, but about preserving the principle that mathematics support should be proactive, structured, and relational. The long-term success of the initiative will depend on whether this principle becomes embedded not only in course design but also in institutional culture.

Challenges and limitations

While the *No Student Left Behind* initiative has been associated with encouraging trends in engagement and performance, several challenges and limitations must be acknowledged. Recognising these constraints is essential both for responsible interpretation of the findings and for informing future development.

A central methodological limitation concerns self-selection. Although participation in preparatory modules, workshops, and learning circles was strongly encouraged, engagement ultimately remained voluntary. It is therefore possible that students who chose to participate were already more motivated, organised, or academically inclined than those who did not.

The observed correlation between module attempts and final grades, while statistically significant, does not establish causation. Higher-performing students may have been more likely to engage extensively, rather than engagement alone producing improved outcomes. Although the narrowing of performance gaps following the introduction of early diagnostics is promising, the current design does not allow for definitive causal claims.

Future research could strengthen inference through matched cohort comparisons, longitudinal tracking of failure and retention rates, or more structured comparative research designs that allow stronger causal inference (for instance, using a difference-in-differences approach). At present, findings should be interpreted as suggestive rather than conclusive.

The grade incentive (capped at one additional point out of 20) played a visible role in motivating participation, particularly in the initial phases. While intentionally modest, this incentive may have lowered the threshold for engagement. Nevertheless, the relative influence of intrinsic and extrinsic motivators remains difficult to disentangle. Continued monitoring will be required to assess whether engagement persists if incentive structures evolve.

Another significant challenge relates to workload and staff capacity. The design and maintenance of diagnostic assessments, learning modules, workshops, and peer mentoring structures require sustained faculty effort. Data analysis, communication with students, and coordination across teaching teams further increase time commitments.

Although the initiative has thus far been supported within existing workload models, its continued expansion may place pressure on staff capacity. Without formal recognition of these activities in workload allocation frameworks, there is a risk of over-reliance on individual commitment. Such dependence could make the initiative vulnerable to staff turnover or competing institutional demands.

Sustainability therefore depends not only on pedagogical effectiveness but also on organisational structures that acknowledge and support the labour involved.

The initiative was developed within a specific institutional context: first-year mathematics courses at Nova SBE, characterised by relatively cohesive teaching teams and manageable cohort sizes. Scaling the model to larger cohorts, multiple departments, or institutions with different resource profiles may introduce additional complexities. For example, peer mentoring structures rely on careful recruitment, training, and coordination. Workshop quality depends on facilitator expertise. Diagnostic calibration requires ongoing review to ensure validity across changing cohorts. Replication without sufficient infrastructure could dilute impact. Moreover, cultural elements, such as the normalisation of help-seeking, may not transfer automatically to contexts where mathematics anxiety is more deeply entrenched or where institutional fragmentation limits coordination.

The initiative relies primarily on quantitative indicators such as quiz attempts, exam grades, and participation rates, complemented by qualitative feedback from students. While these measures provide valuable insight, they capture only part of the student experience. Participation does not necessarily equate to conceptual understanding, nor do grade improvements fully reflect shifts in belonging or confidence. Although anecdotal feedback suggests positive affective outcomes, systematic measurement of self-efficacy, anxiety, or belonging has not yet been implemented. Future iterations of the initiative would benefit from more structured evaluation instruments to assess psychological and social dimensions alongside academic performance.

While performance gaps between student groups have narrowed in recent phases, disparities have not disappeared entirely. Structural inequalities related to prior educational access, language proficiency, and socio-economic background cannot be fully addressed through course-level interventions alone. The initiative should therefore be understood as one component within a broader equity strategy. Without parallel institutional efforts addressing admissions pathways, financial support, and academic advising, course-level innovations may have limited reach.

Taken together, these challenges underscore the importance of reflexivity. The *No Student Left Behind* initiative represents an evolving process rather than a finished solution. Its strengths lie in iterative refinement, data-informed adaptation, and openness to revision.

Rather than presenting the intervention as a definitive model of equity transformation, it is more appropriate to view it as an ongoing institutional experiment in inclusive transition pedagogy. Continued evaluation, particularly longitudinal tracking of retention and progression, will be necessary to determine whether early engagement gains translate into sustained academic success.

Discussion and looking forward

Across the three phases of this initiative, a coherent narrative has emerged: efforts to promote equity in first-year mathematics appear to be most effective when they move beyond remediation and instead engage with cultural, structural, and relational dimensions of learning. From *Bridging the Gap* to *Closing Equity Gaps* and *No Student Left Behind*, the experience at Nova SBE suggests that inclusive excellence may be strengthened when pedagogy, data-informed reflection, and deliberate attention to belonging are aligned.

The evidence presented indicates several important patterns:

- Engagement is positively associated with achievement, reinforcing the potential value of formative assessment and self-regulated learning practices (Nicol & Macfarlane-Dick, 2006).
- Early diagnostic assessment appears to support timely intervention and may enhance students' sense of agency and direction (Crisp, 2012; Carless & Boud, 2018).
- Structured opportunities for peer interaction and faculty encouragement are consistent with literature highlighting the role of belonging in sustaining persistence (Thomas, 2012; Kahu & Nelson, 2018).

At the same time, these findings should be interpreted with appropriate caution. While engagement and performance trends are encouraging, the current evidence does not permit definitive causal claims. Self-selection effects, incentive structures, and cohort differences may all contribute to observed outcomes. Ongoing longitudinal analysis will be necessary to determine whether early gains translate into sustained reductions in failure, dropout, or performance disparities.

Over three years, the initiative evolved from a set of self-paced revision modules into a more integrated learning ecosystem combining diagnostic insight, structured practice, mentoring, and community-building. This progression underscores the importance of iterative development. Rather than relying on a single intervention, the approach has involved continuous adjustment in response to data, student feedback, and institutional reflection.

Equity in mathematics, as this case suggests, is unlikely to be achieved through isolated support measures alone. It requires attention to how expectations are communicated, how effort is incentivised, how

help-seeking is normalised, and how students experience belonging within the discipline. When students are provided with early information about their readiness, structured pathways for improvement, and visible encouragement from both faculty and peers, engagement appears more likely, but it is not guaranteed.

The broader implication for first-year higher education is that inclusive excellence may depend less on the quantity of resources provided and more on how those resources are framed, integrated, and culturally embedded. Creating environments in which preparation, collaboration, and reflection are understood as normal components of academic growth may contribute to more equitable transitions.

No Student Left Behind should therefore be understood not as a completed solution, but as an evolving institutional commitment. Its continued relevance will depend on sustained evaluation, organisational support, and openness to adaptation. If mathematics is often positioned as a gatekeeping discipline, initiatives such as this suggest that it can also become a structured bridge, as long as equity, belonging, and academic rigour are pursued together.

Biographies

Patrícia Xufre is an Associate Professor at Nova School of Business and Economics, Portugal, where she teaches quantitative methods and serves as Director of the Teaching Excellence and Innovation Center and Academic for Quality. Her work focuses on innovative pedagogical practices, gamification in higher education, and inclusive strategies to support diverse learning backgrounds, particularly in first-year courses. She is passionate about fostering engagement, collaboration, and a sense of belonging in quantitative disciplines.

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Áurea Quintino is an Assistant Professor at Nova School of Business and Economics, Portugal, where she teaches undergraduate mathematics courses. She holds a Ph.D. in Mathematics from the University of Bath, UK, and she is passionate about teaching and strongly committed to student success and well-being.

Tânia Zaragoza is an Assistant Professor at Nova School of Business and Economics, Portugal, where she teaches undergraduate mathematics courses, with a strong commitment to inclusive education and student well-being, without compromising a rigorous, meaningful approach and a deep understanding of mathematical concepts.

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Ethical Considerations

Ethical approval for the use of anonymised student performance data and feedback was granted by the Institutional Review Board of Nova School of Business and Economics, reference number #25182. All data were analysed in aggregate form in accordance with institutional data protection policies.

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