The First-Year Baseline: Evaluating Student Readiness Supplemental Learning Pathways

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Abstract. The transition from secondary school to higher education can be a critical milestone in a student's academic journey, particularly in STEM fields. Without a precise understanding of entry-level competencies, the design of university curricula rests on uncertain foundations. This study examines the necessity of diagnostic entry assessments, highlighting that traditional parameters (such as admission scores and high school graduation results) fail to accurately predict readiness and do not provide precise information on whether a student is prepared to succeed in higher education. By implementing an adaptive measurement model, the Budapest University of Technology and Economics (BME) successfully identified content-knowledge gaps among first-year students. Consequently, BME introduced structural interventions: implementing differentiated instruction and launching remedial courses designed to reduce dropout rates and shift the institutional focus from correction to prevention.

Keywords: diagnostic assessment, grade inflation, massification, ZPD, adaptive test, talent management, remediation

1 Introduction

1.1 The Necessity of Diagnostic Assessments

The significance of diagnostic assessments conducted upon entry into higher education has grown steadily over recent decades, particularly in STEM fields. With the massification of higher education – that is, the emergence of mass higher education – the student body has become exceptionally heterogeneous. Consequently, institutions can no longer rely solely on secondary school performance. Prior research, such as studies by Molontay and Nagy [1], as well as Geiser, and Santelices [2], has clearly demonstrated that while high school grades may be useful for establishing a general entry threshold, in most cases they are unreliable predictors of subsequent university performance. Diagnostic assessments are intended to fill this gap, helping to construct a more precise picture of first-year students' actual competencies, thereby mitigating the risk of early attrition. Dropout rates are a particularly critical problem in natural science and engineering programs, where as many as 30 to 50 percent of students may leave their chosen

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field due to academic failure resulting from deficient foundational knowledge [3], [4]. The root cause of this phenomenon is often that students, at the moment of admission, lack the essential mathematical skills indispensable for successfully navigating rigorous, cumulative university curricula [5].

Multilevel diagnostic tests are increasingly being adopted in engineering education to determine the extent of the knowledge gap that emerges during the transition from high school to university. Unlike traditional admission procedures that often rely exclusively on summative evaluation, these entry assessments clearly serve formative purposes: their objective is not to label or filter out students, but rather to achieve a fine-tuned identification of deficiencies and to prepare institutional interventions [6]. Longitudinal studies consistently confirm that diagnostic test results are among the most reliable predictors of first-year university mathematics performance – in some cases predicting success or failure orders of magnitude more accurately than incoming high school scores [7], [8]. Modern psychometric tools go far beyond simple multiple-choice questions. They utilize multidimensional cognitive evaluation systems capable of precisely uncovering not only a lack of explicit knowledge, but also students' specific conceptual misconceptions and logical errors [9]. During the institutional validation of diagnostic tools, experts pay special attention to ensuring that tests accurately represent the required proficiency levels – from factual knowledge and routine procedures to complex problem-solving – thereby guaranteeing an exact assessment of competencies mandated for introductory engineering courses [9]. Furthermore, with the international rise of data-driven learning analytics, such assessments enable the integration of predictive machine learning algorithms. By synthesizing student profiles and diagnostic results, these algorithms can identify students at risk of dropping out within the very first weeks of the semester with remarkable accuracy [10], [11].

However, the true, paradigm-shifting value of entry diagnostic assessments lies in their creation of a robust scientific and empirical foundation for differentiated instruction and personalized student support. A crucial insight is that assessment alone does not reduce attrition; testing must always be followed by a well-structured and easily accessible institutional support system [5]. Research conducted across numerous European higher education institutions demonstrates that at-risk first-year students who were immediately routed into dedicated Mathematics Learning Centres or mandatory remedial courses based on their diagnostic results completed their first academic year at significantly higher rates and with better outcomes than their peers with similar indicators who were excluded from targeted support [12], [13]. The efficacy of such interventions is enhanced when feedback on the tests is immediate, detailed, and explanatory, thereby helping students address their knowledge gaps before the examination period begins [14]. Furthermore, student attitude surveys highlight that when an institution communicates the purpose of the tests transparently and supportively, students do not perceive them as punitive, but rather as useful guidance that aids their own learning process [12]. In light of all this, diagnostic assessments embedded within higher education – and specifically within STEM-focused programs – are essential, strategically vital tools for managing student heterogeneity. Evidence-based decision-making, early intervention, and individual student mentoring all rely on precise diagnostic data, which

ultimately play a decisive role in creating equal educational opportunities and in training high-quality graduates who meet contemporary labor market expectations [3], [15].

1.2 NAT 2020 and Its Consequences

Assessing the knowledge level of students entering Hungarian higher education has become critically important in recent years. This need has been significantly amplified not only by the general massification of higher education, but also by recent structural and content-related reforms within the domestic public education regulatory framework. The introduction of the 2020 National Core Curriculum (NAT 2020), along with the associated modifications to framework curricula and secondary school leaving examination (matura) requirements, created a period of transitional curricular turbulence. This turbulence has drastically intensified the heterogeneity previously observed among incoming first-year students [16], [17].

The introduction and implementation phase of NAT 2020 brought substantial shifts in content and instructional hours across Hungarian public education. Changes in the instruction of natural science subjects (physics, chemistry, biology), the reduction of mandatory class hours, and the introduction of an integrated science subject in certain school types have resulted in drastic disparities in the conceptual networks and actual knowledge bases of students coming from different secondary schools [18], [19]. The current transitional period is particularly problematic, as students educated and examined under both the old (2012) and the new (2020) core curricula are entering higher education simultaneously. This "dual curriculum" background means that university instructors can no longer assume a uniform baseline of high school knowledge. Research shows that during transitional years of curricular reforms, students' incoming knowledge is far more unpredictable, necessitating objective diagnostic assessments tailored to specific university requirements during registration week or the very first days of the term [20].

The justification for diagnostic assessments is further reinforced by the continuous decline in the predictive validity of matura scores. High scores obtained in the Hungarian university admissions system often obscure deep quality and methodological divides between elite grammar schools (gimnázium) and vocational institutions (technikums, vocational grammar schools). Hungarian higher education research highlights that success on high school examinations, or even advanced-level matura exams, frequently fails to correlate with the abstract reasoning skills and problem-solving routines required in higher education, especially in engineering programs [21], [22].

In response to this heterogeneous and uncertain entry state, several Hungarian institutions have introduced mandatory placement tests. These specific diagnostic tools measure the exact foundational competencies (e.g., algebraic transformations, functional basics, fundamental laws of physics) without which mastering university-level course content is impossible. The goal of these measurements is not screening or gatekeeping, but targeted intervention: identifying "criterion courses" and remedial courses for incoming students who display knowledge gaps [16], [23]. Experiences in Hungary also demonstrate that students who participate in intensive remedial mathematics or physics courses running parallel to their first semester – based on diagnostic results –

complete their absolute (degree requirements fulfilled) status at significantly higher rates than those who begin their studies directly in the standard curriculum despite their deficiencies [22].

It can be argued, therefore, that public education regulatory changes – specifically the knowledge asymmetries caused by the introduction of NAT 2020 and the two-tier examination system – have forced Hungarian higher education onto a necessary path. Diagnostic assessments are now essential cornerstones of quality assurance, educational equity, and student retention. Higher education must accept responsibility for compensating for entry-level deficiencies, the first and most vital step of which is a fact-based, transparent, and professionally grounded assessment of students' actual cognitive states [20], [24], [25].

2 Adaptive assessment

Due to the diverse knowledge levels of first-year students, traditional (linear) entry assessments that use identical sets of questions for everyone are often unable to address this broad spectrum effectively. Computerized Adaptive Testing (CAT), by contrast, adjusts the difficulty of subsequent questions based on the student's current answers. Applying this type of measurement offers several advantages.

Table 1 outlines the fundamental differences between the two approaches within the context of entry-level assessments.

Table 1. Differences between the two approaches within the context of entry-level assessments

	Traditional (Linear) Assessments	Computerized Adaptive Testing (CAT)
Question Composition	Identical for everyone (or a few fixed variations)	Personalized, dependent on previous answers
Measurement Accuracy	High at the average proficiency level, imprecise at the extremes	High across the entire knowledge spectrum (for both weak and top performers)
Resource Efficiency	Long test duration required to cover the full spectrum	Up to 50% fewer questions and reduced test time
Test Security	High risk of collaboration among test-takers with identical tests	Virtually no two item sets are the same

2.1 The Diagnosis

At BME, we have been using an adaptive test upon entry since 2024. In 2024, this test was an adaptive mathematics test supplemented by a dedicated reading comprehension module. The assessment took 100 minutes and was conducted on the EduBase online learning platform. In 2025, this test was further expanded to include a physics module. It is important to note that the entry-level assessment is often a student's first major interaction with the university. A student with gaps in their knowledge can experience

continuous failure on a linear test, which can breed immediate anxiety and demotivation. An adaptive test, by contrast, aligns much better with their actual proficiency level, ensuring they also receive solvable tasks. Excellent students, on the other hand, do not become bored with basic questions, but rather receive higher-level problems that stimulate them intellectually. In both cases, the testing experience feels significantly fairer and more professional.

Test system: EduBase

The entrance examinations were administered utilizing EduBase (www.edubase.net), an adaptable online assessment and learning platform. A primary advantage of this system is its capacity for real-time data aggregation and feedback, granting educators instantaneous insights into student performance metrics. Furthermore, EduBase incorporates sophisticated anti-cheating mechanisms to safeguard exam integrity and validity. The inclusion of parameterizable items also facilitates the efficient generation of highly customized exam variations.

Beyond its core assessment capabilities, EduBase exhibits extensive scalability, accommodating diverse user bases ranging from intimate classroom settings to large-scale corporate enterprises. Its architecture allows for frictionless integration with pre-existing infrastructure, such as Learning Management Systems (LMS) and other institutional software. Consequently, this operational flexibility and ease of integration ensure that EduBase functions seamlessly across a wide spectrum of educational and professional training environments.

Test structure and results

The adaptive diagnostic assessment was structured into a three-stage testing pipeline designed to evaluate both procedural automaticity and high-level conceptual mathematical competencies (Fig. 1).

In the initial stage (Block 1: Basic Questions), students' foundational procedural arithmetic and computational fluency were evaluated through tasks covering elementary operations, algebraic identities, linear equations, inequalities, basic trigonometric functions, and fundamental analytic geometry. The vast majority of these items required 10^{th}-grade secondary school proficiency. Test-takers were required to solve 20 questions within a strictly allocated 10-minute time constraint without the use of calculators.

Following the foundational phase, participants were branched into two distinct cohorts in the second stage (Block 2) based on their secondary school track: those who attended advanced preparatory mathematics electives (*Facultation* / F) and those who followed the standard secondary curriculum (*Non-Facultation* / NF). In this stage, students completed 15 or 16 questions within a 50-minute testing window, comprehensively assessing the secondary mathematics curriculum. A subset of anchor items was identical across both groups to enable direct cross-cohort calibration and empirically establish the performance boundary separating the tracks. Real-time performance tracking within the EduBase platform delivered immediate automated scoring, routing students to their corresponding third-stage level without administrative delay.

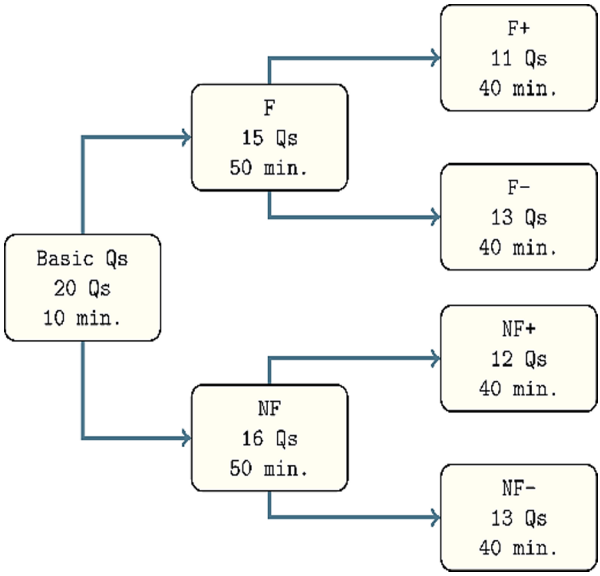


Fig. 1. Adaptive test structure

In the final stage (Block 3), the cohort was partitioned into four specialized streams based on whether their second-block performance met or fell below a 50% threshold: Facultation+ (F^+), Facultation- (F^-), Non-Facultation+ (NF^+), and Non-Facultation- (NF^-). Advanced-track students who scored $\geq 50\%$ progressed to the F^+ sub-battery (11 items), while those achieving $< 50\%$ were directed to F^- (13 items). Similarly, standard-track students scoring $\geq 50\%$ advanced to NF^+ (12 items), whereas those scoring $< 50\%$ were routed to NF^- (13 items). Although item counts varied to reflect group-specific psychometric goals, an identical 40-minute duration was allocated across all four streams. Across these final modules, cross-assigned anchor items from adjacent levels were embedded to refine classification near the boundary zones, providing an accurate, multi-tiered diagnosis of incoming student preparation.

The foundational phase (Block 1: Basic Questions) evaluated students' core procedural and computational fluency. In 2024, this initial module was completed by N = 1,372 incoming freshmen, yielding an overall average of 58.72% with a standard deviation of 19.4%. The empirical score distribution approximated a Gaussian curve (Fig. 2/a), successfully mastered only by students possessing robust and automated calculation routines. With a rigid 10-minute time constraint allocated for 20 sequentially arranged tasks, test-takers had approximately 30 seconds per question. The item-by-item analysis in 2024 (Fig. 2/b) delineated a precipitous decline in student performance: while the initial question registered a 94.04% success rate, the proportion of correct solutions dropped to just 11.41% by the final task. Concurrently, both unanswered and unopened items rose substantially past the halfway mark. In the fixed-order testing setup of 2024, this pattern conflated content difficulty with severe time-management constraints and fatigue, leaving the terminal items unattempted by a significant fraction of the cohort. To overcome the diagnostic blind spot regarding the latter half of the

question pool and obtain an unskewed evaluation of all targeted item types, structural revisions were implemented in the 2025 assessment: The test length was expanded to 25 questions, and the allocated time was increased to 15 minutes (ca. 36 seconds per item). The presentation order was fully randomized across participants instead of using a fixed linear sequence. Despite the expanded timeframe and arbitrary sequencing, the comparative analysis across cohorts (N_{2024}= 1,372 vs. N_{2025}= 2,389) reveals a striking consistency in student error profiles. In both years, the specific mathematical operations that students struggled with were virtually identical. Pronounced performance drops and error spikes consistently emerged on elementary conceptual items – such as fundamental absolute-value inequalities, exponential identities, and basic trigonometric or logarithmic evaluations. Furthermore, the data confirm that first-year students remain remarkably slow in basic calculation routines. The cognitive latency and pervasive lack of fluency in elementary procedural tasks highlight a critical vulnerability: these core mathematical mechanisms are insufficiently automated. When foundational mathematical schemas are fragile or unformed, they inevitably resurface as acute bottlenecks – "backfiring" throughout subsequent higher-education coursework where introductory engineering and calculus curricula presuppose procedural fluency as an implicit prerequisite. These findings indicate that addressing these deficiencies cannot remain the sole burden of post-secondary remediation. The systemic stability of these errors across consecutive cohorts points to an urgent imperative: these elementary calculation skills and conceptual cornerstones must be reinforced and solidly consolidated earlier, preferably within secondary education, before students transition into rigorous STEM university curricula.

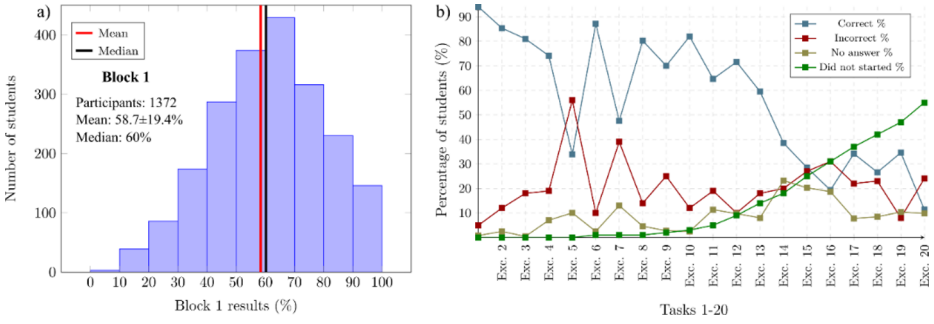


Fig. 2. Results Block 1: a) histogram of results and b) change of results by tasks [24]

2.2 The Therapy

Educational researchers and psychologists employ various theoretical frameworks to support the necessity of differentiation (such as remedial courses, ability grouping, or adaptive e-learning) in higher education. One such framework is John Sweller and colleagues' Cognitive Load Theory, which posits that working memory capacity is limited. The high level of abstraction in university-level mathematics places a substantial burden on students by itself. If a student lacks the automated schemas that represent a solid high school foundation, the learning material causes cognitive overload, which hinders

learning. This can be optimized through differentiated instruction – such as a slower-paced remedial course utilizing more worked examples – which enables students with weaker prior knowledge to construct the missing schemas [26]. Another foundational higher education pedagogy approach is Lev Vygotsky's developmental psychology model, specifically the concept of the Zone of Proximal Development (ZPD). This states that learning occurs when the difficulty of the material exceeds the student's current level of knowledge, but remains attainable with instructional support (scaffolding). Due to the highly dispersed student body inherent in mass education, a uniform curriculum tailored to the average is too easy and boring for some, while far too difficult for others, leading to failure. Differentiation realized through diagnostic-based placement, however, ensures that students receive tasks corresponding to their own zone of proximal development [27].

In the practical implementation of differentiation, it is paramount that the output requirements of the institution and the given degree program are not compromised. Regardless of the entry level, pace, or thematic focus of the group in which a student begins their studies, at a given point in the program – by the end of the courses – they must fully master the standardized minimum knowledge and competency system required by degree quality assurance, labor market expectations, and professional standards. Differentiation may therefore entail individualizing learning pathways, timeframes, and pedagogical methodologies, but it must never result in lowering final expectations or relaxing professional standards, as this would lead to the devaluation of higher education degrees.

From an educational methodology perspective, the results of entry-level competency assessments function as a form of pedagogical diagnosis. Following the assessment, this diagnosis imperatively requires targeted intervention – that is, "therapy" tailored to student needs. Guided by this principle, performance data derived from adaptive testing are applied to differentiate mathematics instruction and to precisely identify the cohort of students in need of remediation. Our system is currently based on a two-tier structural model, the limitations of which are becoming increasingly clear as assessment data are refined. Under current practice, cohort "Level A" comprises students who, at the moment of entry, already firmly possess the applicable foundational knowledge essential for beginning higher education studies. Group "Level B" consists of first-year students whose prior knowledge requires supplementation or correction. Their deficiencies stem from two underlying causes: although they took advanced mathematics tracks in secondary school, they did not master the material at an adequate level (mastery, i.e., competency gaps), or they studied mathematics at the standard level (structural, i.e., curricular gaps). Exceptional performance under standard-level curricular requirements could also qualify a student for the "Level A" cohort. However, adaptive diagnostics revealed that the knowledge level of students assigned to "Level B" is extremely heterogeneous, as different root causes lie behind their knowledge gaps.

A deep analysis of the results demonstrates the necessity of integrating a third category requiring specialized intervention: "Level C." The data clearly identify a student base struggling with severe and systemic foundational deficits. For these students, traditional remedial courses running parallel to regular university coursework cannot prove effective, as the cognitive schemas required to absorb university-level concepts

are entirely lacking. For the "Level C" group, professional "therapy" would ideally take the form of an intensive, pre-university bridging phase. This implies that instruction of specific higher education curricula should be delayed for them; the course must first focus on a comprehensive reconstruction of secondary school core competencies, and meaningful university coursework can only commence after these solid foundations have been successfully established. In Hungarian higher education, establishing "Level C" in this exact manner appears difficult to implement. Starting in September of the 2026/2027 academic year, we are launching a remedial course for the lowest-performing students in which retrieval practice and independent self-remediation will play a central role.

2.3 A More Effective Solution

Higher education remediation is a double-edged sword. While successfully reinforcing missing foundations can protect a student from immediate academic failure and increase their chances of graduation, poorly structured, non-credit, and prolonged compensation can also inflict damage. Addressing the secondary school deficiencies of first-year students and evaluating the effectiveness of university remedial education represents a complex and debated area of educational research. Although the fundamental goal of institutions is to reduce attrition and establish missing foundations, the literature highlights that remediation conducted within traditional frameworks often fails to yield the desired outcomes and, in certain cases, actively demotivates students. Calcagno and Long (2008) draw attention to the long-term limitations of remediation. Analyzing the impact of mandatory remedial courses, the authors concluded that these interventions are mostly effective only in the short term: although remedial subjects aided persistence – the transition from the first fall semester to the spring – they did not increase the long-term likelihood of actually earning a degree [28]. The psychological and structural causes underlying this lack of success are explored in a study by Scott-Clayton and Rodriguez. The authors identified the so-called "discouragement effect." Their research shows that when students are forced to take zero-credit preparatory courses that yield no meaningful degree progress, many experience it as a penalty. They feel that mandatory obstacles divert them from their original goals, leading a significant portion to simply give up and drop out [29].

However, research by Bettinger and Long proves that under proper structural conditions, remediation can indeed protect students from university failure. Their findings indicate that students required to take remedial mathematics were ultimately more likely to remain in higher education and complete their degrees compared to peers of equal ability who avoided remediation [30]. This finding suggests that in certain disciplines – particularly fields relying on strict course sequencing and theoretical foundations – stabilizing high school mathematics is an indispensable prerequisite for a student to even stand a chance of succeeding in university studies.

The Scientific Background of Institutional Outreach

Regarding the prevention of dropout among incoming higher education students, educational science research increasingly urges a paradigm shift: instead of retrospective, often delayed, and demotivating university remediation, emphasis must be placed on preventive bridge programs operating between high school and university. Preventing university attrition should not begin in the first examination period, nor even in the weeks immediately following enrollment. Following the failures of traditional remedial education running parallel to university studies, the focus has shifted toward proactive bridge programs (and dual enrollment) that facilitate the transition between secondary and higher education. In his comprehensive monograph *Completing College: Rethinking Institutional Action*, Vincent Tinto emphasizes that institutions cannot wait to offer support until students have already drifted to the brink of dropping out. The author highlights that the most vital condition for successful academic and social integration is establishing a clear system of expectations communicated to students prior to beginning formal university coursework. Tinto's research proves that universities must build proactive relationships with students as early as the final years of high school. Bridge programs provide precisely this protected environment that nonetheless sets realistic university expectations. When students become familiar with the pace of university coursework, expected autonomy, and academic ways of thinking in advance through anticipatory socialization, entry shock is significantly reduced [31].

In STEM programs, entry-level deficiencies are exponentially magnified because these disciplines rely on strict hierarchies and cumulative sequencing. Terrell L. Strayhorn's research, *Bridging the Pipeline: Increasing Underrepresented Students' Preparation for College Through a Summer Bridge Program*, specifically analyzed the effectiveness of intensive, pre-college preparation programs. Strayhorn's study demonstrated that proactive bridge programs – which, unlike zero-year university remediation, do not carry the psychological burden of "punishment" and "lost time" – measurably increase students' mathematical and scientific readiness. The key conclusion of the research is that students participating in these types of programs required traditional remedial instruction during their university years at significantly lower rates. The preventive model thus not only reduced student frustration but also relieved capacity pressures for universities, as students arrived for their first semester with mathematical foundations that enabled a smooth transition into core discipline subjects [32].

Domestic research also confirms that the success of the transition between secondary school and university depends heavily on students' prior institutional integration and the formation of supportive micro-communities. Translating this insight – validated by both international and Hungarian research – into practice, BME created its graduation and university preparation, knowledge-reinforcement program named *MIssion Possible*. The initiative aims to bridge the gap between high school and university before students enter higher education, specifically focusing on the most critical areas of mathematics and physics. The target audience of the program is precisely the demographic where prevention is most effective: students in their penultimate year of high school, graduating seniors, or secondary school graduates who have not yet commenced their university studies. The concept of *MIssion Possible* breaks away from traditional exam preparation based on passive knowledge transmission, focusing instead on long-term knowledge reinforcement that supports university retention.

The program aligns with the structural specificities of the Hungarian higher education system: since national university regulations do not allow for continuous, cross-semester (year-long) subjects, the curriculum was announced on a per-semester basis, split into fall and spring terms (Mathematics 1–2 and Physics 1–2, respectively). Both modules ran for 18 weeks per semester with an intensive class load of 4 contact hours per week, fully transferable as academic credits under institutional partial-studies framework regulations.

First-year program data clearly illustrate the divergent learning curves of the two disciplines and the impact of academic workload on students. A total of 74 students enrolled in the Mathematics 1 course. The grade distribution shifted heavily toward high academic achievement: 39 students earned an excellent mark (Grade 5), and only 2 failed. Notably, a substantial number of passing marks were also recorded (18 students receiving Grade 2). In the spring semester, none of the examined students failed, and the course average rose to 4.05. Among students who completed both semesters ($n = 57$), 52.6% maintained their earlier grade, 15.8% improved, and the 31.6% who experienced a decline was primarily an artifact of the statistical ceiling effect following the high concentration of top marks in the first semester.

The physics sequence presented a considerably steeper challenge for secondary school participants. In the fall semester, Physics 1 grades exhibited a pronounced bimodal distribution: 18 students (32.7%) failed, while 11 students (20.0%) achieved an excellent mark (Grade 5). Among those who progressed to Physics 2, the average mark rose to 3.17, which can be attributed to academic selection and the attrition of the lowest-performing cohort after the first semester.

A weekly commitment of 2×4 hours (totaling 8 contact hours per week) over 18 weeks posed a substantial obstacle for students who were simultaneously completing secondary school and sought to study both disciplines. In the fall semester, 22 students chose to take both courses concurrently. Within this cohort, a sharp performance gap emerged between the subjects: while they achieved a mean grade of 3.45 in mathematics (with 9 students earning Grade 5), their mean in physics reached only 2.11, with half the group (11 students) receiving a failing grade. Due to this heavy academic burden, several students chose not to continue with both subjects into the spring semester. Ultimately, 15 of the 22 students completed all four courses (a 68.2% retention rate). The 7 attrited students left the complete program almost exclusively because they withdrew from physics.

The MIssion Possible program proved effective not only in providing transferable course credits, but also in offering tangible advantages in university admissions. Under BME Admission Regulations, applicants who successfully complete (at $\geq 60\%$) an institutional preparatory course of at least 120 contact hours are eligible for institutional bonus points. Based on the criteria of the program, 62% of applicants in mathematics (46 students) and 64% in physics (35 students) earned official institutional certification for bonus points.

The first-year outcomes of MIssion Possible substantiate the value of proactive bridge programs: the vast majority of completing students enter higher education with accredited credits and reinforced foundational competencies. Concurrently, the initial results make evident that concurrent dual-subject enrollment alongside regular high

school studies (8 contact hours weekly) places an excessive burden on students. Consequently, future iterations must place enhanced methodological focus on balancing curriculum workload scheduling and providing targeted foundational support in physics.

3 Conclusion

We demonstrated that traditional entry metrics, such as high school grades and graduation scores, are no longer reliable indicators of student readiness for higher education. Amid the challenges posed by massification and recent curricular changes, we showed that the incoming student body exhibits significant knowledge heterogeneity, particularly in critical STEM areas. To address these disparities effectively, we implemented computerised adaptive testing, which enables us to make precise and constructive diagnoses across the entire performance spectrum. Our findings emphasise that such diagnostics must inform targeted institutional interventions directly, utilising frameworks such as Cognitive Load Theory and the Zone of Proximal Development to guide differentiated learning pathways. At the same time, we firmly maintain that, although instructional pacing and methodologies should be tailored to individual needs, the output standards and competencies required for our qualifications must not be compromised. Recognising the limitations and potential demotivating effects of prolonged, parallel remediation, we emphasise the need for a decisive paradigm shift towards proactive support. Initiatives such as our Mission Possible bridge programme demonstrate how universities can engage prospective students prior to formal enrolment and reinforce foundational knowledge in advance. Ultimately, we argue that embedding precise, adaptive diagnostics alongside anticipatory, preventive bridging programmes provides higher education institutions with a sustainable, evidence-based model for reducing dropout rates, fostering educational equity and ensuring long-term academic retention.

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