# Personalised Formative Assessment in Ukrainian Higher Education: Design and Empirical Evaluation of the SMART-PL Model

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**Abstract:** This paper reports the design, implementation and empirical evaluation of a personalised learning (PL) model developed for Ukrainian higher education during 2022–2025, under the Erasmus+ Capacity Building project SMART-PL – *Students' Personalised Learning Model, Based on the Virtual Learning Environment of Intellectual Tutoring "Learning with No Limits"*. The project was coordinated by Tallinn University of Technology and implemented by six Ukrainian universities. Two contributions are advanced. The first is a four-stage design pattern for consortium-level PL adoption in transitional higher education systems: comparative benchmarking of European and Ukrainian practice; negotiated guidelines specifying PL principles, actors, stakeholders and a piloting roadmap; an explicit metric framework for knowledge acquisition and academic progression; and platform-mediated piloting through an information-diagnostic Moodle-based platform with instructor-authored, rule-mapped feedback blocks. The second is empirical evidence from a one-semester pilot (mid-January to mid-June 2025) across the six Ukrainian universities, engaging 772 students and 64 academic staff across all ten ESCO-aligned ICT professional qualification areas. Survey response rates of 42–71% exceeded thresholds typically required for generalisable findings in educational research. The Improvement Curve metric – relative score change between consecutive attempts on the same competency-aligned test – showed a median gain of 17% (range 9–38%) between the first and second attempt, with upward trajectories sustained across third, fourth and fifth attempts and second-and-subsequent attempts systematically crossing the platform's competency threshold of approximately 8/20. The evidence supports the claim that system-generated feedback tied to identified knowledge gaps produces measurable and consistent learning gains under repeated attempts. The four-stage design pattern is transferable to other Eastern Partnership and accession-track higher education systems.

**Keywords**: Personalised Formative Assessment, Remediation Feedback, Competency-Based Assessment, Moodle Virtual Learning Environment, Erasmus+ CBHE

## 1. Introduction

The Ukrainian higher education system entered the period 2022–2025 under a layered set of pressures. The full-scale invasion that began in February 2022 disrupted university infrastructure, displaced students and staff, and reshaped admission cohorts to include returning veterans, internally displaced persons and learners forced into asynchronous or hybrid modes by air-raid alerts (Lugovyi et al, 2023; Londar et al, 2023). Ukraine's candidate-country status and its long-standing Bologna commitments have, at the same time, intensified the alignment work required of universities on quality assurance, student-centred learning and recognition of non-formal credit (Kremen at al, 2021). The combination of these factors is crucial: a HE sector required to deliver flexibility, inclusivity and measurable quality simultaneously, with reduced institutional capacity and a student population.

This paper reports on the design, implementation and empirical evaluation of a personalised learning (PL) model developed under the Erasmus+ CBHE project SMART-PL — *Students' Personalised Learning Model, Based on the Virtual Learning Environment of Intellectual Tutoring "Learning with No Limits"* (2023–2025). The project was coordinated by Tallinn University of Technology and a consortium of six Ukrainian universities, supported by the Institute of Higher Education of the National Academy of Educational Sciences of Ukraine (IHE NAESU) and the National Agency for Higher Education Quality Assurance (NAQA). The model combines a Moodle-based information-diagnostic platform with hybrid co-working centres operating under a *Learning with No Limits* principle of access regardless of age, socio-economic status or modality of participation.

The remainder of the paper presents the model, the data and the limitations of the design, and identifies the elements that are transferable to other Eastern Partnership and accession-track higher education systems facing comparable combinations of pressure.

## 2. Background and Related Work

### 2.1 Formative Feedback, Personalised Learning and Adaptive Systems

The empirical case for tightly-coupled feedback as the active ingredient in instructional productivity was made by Black et al (2009), whose synthesis of more than 250 studies reported effect sizes between 0.4 and 0.7 standard deviations with the most pronounced gains accruing to lower-achieving students. Bloom's (1984) "2-sigma" observation – that one-to-one tutoring lifts learners roughly two standard deviations above conventional group instruction – has functioned ever since as the benchmark against which technology-mediated personalisation is measured.

The project does not operationalise personalisation as learner-driven pathway choice, algorithmic content sequencing or adaptive difficulty selection. It operationalises personalisation as *personalised formative assessment and remediation*: a student's item-level response pattern on a competency-aligned diagnostic test determines which instructor-authored feedback block, and which tier of curated remediation resources, that student receives. The unit of personalisation is the diagnosed knowledge gap. Two students sitting the same test on the same competency receive different remediation if their item-level error patterns and score bands differ. This places the model within the data-driven-instruction and mastery-progression strands of the personalised-learning literature (Means and Neisler, 2018; Pane et al, 2017) and it follows directly from the consortium's decision to keep feedback authorship with the responsible instructor for reasons of pedagogical coherence and accreditation traceability.

### 2.2 The Ukrainian Higher Education Context

Two strands of recent Ukrainian scholarship frame the SMART-PL setting. The first documents the wartime transformation of the sector: institutional displacement, contracted physical capacity, reconfigured admission processes and the rapid normalisation of distance and hybrid delivery (Lugovyi et al, 2023). The second strand concerns the longer-running alignment with the European Higher Education Area, which includes competency-based curricula, learning outcomes, internal quality assurance and individual educational trajectories formalised in the 2014 Law on Higher Education. What is conspicuously thin in this literature is multi-institutional empirical evidence on how a platform-mediated personalised learning model performs under Ukrainian wartime conditions, as distinct from the better-studied Anglo-American and Western European contexts. The project reported in this paper is intended to address that gap.

The paper initiates two main research questions. RQ1: what design pattern emerges when a European–Ukrainian consortium negotiates a personalised learning model for shared implementation? RQ2: does platform-mediated formative feedback, tied directly to identified knowledge gaps and tracked by an Improvement Curve metric, produce consistent learning gains under repeated assessment?

## 3. Method: the Four-Stage Design

SMART-PL was structured as a sequential design-and-evaluation pipeline. The four stages ran in dependent order: each stage produced an artefact that constrained the next. Stage I conducted a structured comparative benchmarking of European and Ukrainian PL practice across seven institutional dimensions (Section 4). Stage II converted that benchmarking output into consortium-level guidelines specifying PL principles, actors, stakeholders and a piloting roadmap (Section 5). Stage III defined the metric framework – test items, instructor-authored feedback blocks linked to identified gaps, a cut-off threshold and an Improvement Curve metric – and set it up as a Moodle-based platform (Section 6). Stage IV deployed the platform in a one-semester pilot at the six Ukrainian partner universities (Section 7).

The consortium comprised TalTech (coordinator, Estonia), KU Leuven (Belgium), Politechnika Wrocławska (Poland) and six Ukrainian universities – Khmelnytskyi National University (KhNU), V. N. Karazin Kharkiv National University (KKNU), Kryvyi Rih National University (KNU), Ivan Franko National University of Lviv (IFNUL), Odesa National Polytechnic University (ONPU) and Kherson State University (KSU) – supported by IHE NAESU and NAQA.

## 3.1 Stage I — Comparative Benchmarking of European and Ukrainian PL Practice

### *3.1.1 Purpose and Design*

The first stage was conceived as a structured mapping intended to establish what each partner was actually doing, where the systemic gaps lay and which gaps were tractable within a three-year project. The exercise was led by IHE NAESU and conducted across seven institutional dimensions: (i) key features of the PL model in use; (ii) institutional policies framing PL; (iii) infrastructure, environments, tools and LMS supporting PL; (iv) departments and staff with named responsibility for PL; (v) the integration of PL within the institutional quality assurance system; and (vi) student-facing PL practices, including individual learning pathways, elective choice, formative assessment and tutoring (Kalashnikova et al, 2023). European partners (TalTech, KU Leuven, PWR) supplied institutional self-descriptions across the given dimensions, Ukrainian partners (KhNU, KKNU, KNU, IFNUL, ONPU, KSU) supplied the same self-descriptions and, in addition, conducted staff and student surveys to describe the *current* state.

### *3.1.2 Findings*

Three categories of finding emerged. The first concerns institutional infrastructure for PL. European partners had named, permanently resourced units carrying institutional responsibility for personalised teaching and learning. Ukrainian partners reported diffuse responsibility, typically distributed across deans' offices, methodical councils and individual chairs, and LMS use that was content-delivery oriented. Formative assessment was present in Ukrainian practice but embedded in internal quality assurance cycles, in contrast to European partners where formative cycles were a recognised input to programme-level review.

The second category concerns individual learning trajectories. Ukraine's 2014 Law on Higher Education and subsequent NAQA standards confirm the right of students to individual educational trajectories, and Ukraine is one of the few EHEA member countries to define student-centred learning in national legislation. Survey responses nevertheless indicated that practical implementation was bounded by rigid programme structures, narrow elective windows and weak mechanisms for recognising non-formal learning.

The third category concerns inclusive provision. Ukrainian partners reported more developed institutional services for students with disabilities, internally displaced persons and war veterans than the European partners, reflecting national policy priorities under wartime conditions and predating SMART-PL: dedicated inclusive pedagogy laboratories at KhNU, the Centre for Veteran Development at KKNU, and "Learning Without Limits" centres at ONPU were already in operation when the project began. This finding reframed the consortium's understanding of what was being benchmarked: a mutual mapping in which inclusivity infrastructure flowed in Ukraine – EU direction (Tsybuliak et al, 2024).

## 3.2 Stage II — Consortium Guidelines: Principles, Actors, Stakeholders, Roadmap

### *3.2.1 The Guidelines*

A consortium-level guideline (document specifying personalised learning principles, actors, stakeholders and a piloting roadmap) should not be read as a translation of European practice into a Ukrainian setting. The principles were those that the six Ukrainian partners could implement within the constraints of Ukrainian programme accreditation procedures, NAQA Sectoral Expert Council expectations, and the 2014 Law on Higher Education (Kalashnikova et al, 2022). The European partners contributed practice and pedagogic argument and the Ukrainian partners contributed regulatory feasibility tests.

### *3.2.2 The Five Principles*

The guidelines settled on five operative principles, each defined sufficiently to act on (Morkun et al, 2024). *Individualisation* requires a documented diagnostic step – a baseline assessment of strengths, weaknesses and learning profile – before personalised pathway decisions are made. *Flexibility* requires that institutions offer multiple modes of access (face-to-face, asynchronous online, hybrid) and alternative assessment formats (portfolios, projects, presentations) so that students with work, caring or military responsibilities are not limited by mode of participation (Tsybuliak et al, 2024). *Engagement* is implemented through active learning techniques, structured tutor–student dialogue and tutor-supported reflection. *Data-driven decision-making* requires institutions to use platform-generated assessment evidence as input to programme-level review. *Continuous*

*improvement* requires an annual revision cycle for personalised learning materials and feedback blocks, with ethical data handling treated at every step.

#### *3.2.3 Actors and Stakeholders*

The actor map distinguishes three layers. The classroom layer is the student–instructor communication level, mediated by the platform. The institutional layer comprises departmental quality assurance officers, methodical councils, deans' offices and dedicated inclusion units (inclusive pedagogy laboratory at KhNU, the Centre for Veteran Development at KKNU and the "Learning Without Limits" centre at ONPU). The system layer comprises NAQA, IHE NAESU and external employer stakeholders, including the IT-cluster cooperation network. The employer presence is important: student–instructor–employer engagement at the Co-working Centres is the mechanism by which curriculum revisions initiated under SMART-PL remain calibrated to labour-market expectations.

#### *3.2.4 The Piloting Roadmap*

The roadmap specifies pre-pilot, pilot and post-pilot phases. The pre-pilot phase, completed between September 2024 and January 2025, required each instructor to review and enhance course content, design assessment rubrics and scoring scales aligned with the platform's metric framework, develop a bank of formative and summative test items, and format all resources to platform metadata standards. Technical leads from each Ukrainian partner demonstrated integrated course materials and confirmed launch readiness. The pilot phase is reported in Section 7. The post-pilot phase, ongoing as this paper is written, comprises a second-iteration testing cycle scheduled for the spring 2026 semester and the integration of revised teaching materials into permanent programme accreditation files.

### 3.3 Stage III — Metric Framework for Knowledge Acquisition and Academic Progression

#### *3.3.1 What is Being Measured*

Academic progression is defined as the direction and magnitude of change in a student's measured competency across repeated attempts on the same competency-aligned test, as distinct from the level attained at any single attempt. It is operationalised through two linked quantities. The first is the Improvement Rate (IR) between consecutive attempts, $IR = (S_{n+1} - S_n) / S_n \times 100\%$, where $S_n$ is the score on the n-th attempt; the ordered sequence of IR values across attempts one to five constitutes the student's Improvement Curve. The second is the position of each attempt relative to the competency cut-off of approximately 8/20. A student is recorded as *progressing* when the Improvement Curve trends upward and as having *attained competency* when an attempt crosses the cut-off. The two are reported jointly: an upward curve that never crosses the cut-off evidences movement without mastery, and an above-cut-off score without an upward trajectory evidences attainment without demonstrated progression. The empirical claim of the paper requires both conditions to hold across the pilot population.

#### *3.3.2 Operational Design*

Each pilot discipline was aligned to one of ten ESCO Information and Communications Technology professional qualification fields (e.g. 2521.3 Database developer; 2512.4 Software developer; 2511.3 Data analyst), within each field the responsible Ukrainian partner identified the essential skills to be tested. For each skill, instructors authored a bank of test items in single-correct multiple-choice format with one correct answer and three distractors. Each test comprised 20 items scored on a 20-point scale. Alongside the item bank, each instructor authored a parallel bank of feedback blocks: short narrative remediation texts, each mapped to one or more specific test items, prescribing curated learning resources (textbooks, online courses, hands-on practice platforms, research papers) calibrated to the score band achieved.

Students in the lowest score band receive foundational resources such as introductory textbooks and entry-level practice platforms (Codecademy, freeCodeCamp). Mid-band students receive intermediate-level course material, project-based exercises and applied case studies. High-band students (roughly 9–10 out of 10) receive advanced materials – specialised handbooks, peer-reviewed publications, conference proceedings. The tiering is rule-based. The platform applies deterministic mapping rules from score and item-pattern to feedback block. Algorithmically generated feedback was considered and rejected for two reasons: pedagogical coherence between assessment and remediation requires that the same instructor designs both, and Ukrainian programme

accreditation procedures require traceable academic authorship of all assessment-related instructional content (Kremen et al, 2021; Kalashnikova et al, 2022).

#### *3.3.3 The Improvement Curve Metric*

The principal outcome metric is the Improvement Rate (IR) between consecutive attempts:

$$I\,R = (S_2 - S_1) / S_1 * 100\%$$

where $S_1$ is the first-attempt score and $S_2$ is the second-attempt score on the same competency-aligned test (Boyarchuk et al, 2025). Plotted across attempts 1 through 5 for each student, the resulting trajectory is the Improvement Curve. Two parameters provide criterion-referenced interpretation. The first is the cut-off score, set at approximately 8/20, which represents the platform's threshold for demonstrated competency in the tested skill. The second is the trajectory direction: an uptrending curve is taken as evidence that the remediation loop (test → diagnosed gap → curated resources → re-test) is functioning, while a flat or descending trajectory indicates that either the gap diagnosis or the remediation input has failed for that particular student. The metric is simple: it does not partial out item-level difficulty, test-wiseness or item-familiarity effects, and the constraints this imposes on causal interpretation are returned to in the Discussion.

#### *3.3.4 Platform Used*

The metric framework is implemented in a Moodle-based platform developed by Khmelnytskyi National University. The architecture of a SMART-PL platform includes a relational database for users, courses, items, attempts and feedback blocks; a competency-assessment module that scores attempts and resolves the feedback rule-set; a personalised educational diagram module that visualises the Improvement Curve and projected trajectory against the cut-off; a content management subsystem for course materials and a communication subsystem for student–instructor dialogue, configured with data-handling protocols per the consortium's D.3.1 sharing policy (Lysenko et al, 2024).

### 3.4 Stage IV — Piloting and Empirical Evaluation

#### *3.4.1 Pilot Scope and Participants*

This stage addresses the second research question stated in Section 2, refined into the operational questions the pilot was designed to test. RQ2a: Does platform-mediated formative feedback, tied to diagnosed knowledge gaps, produce an upward Improvement Curve across repeated attempts on the same competency-aligned test? RQ2b: Do repeated attempts move students across the competency cut-off of approximately 8/20 - that is, from diagnosed gap to demonstrated competency? RQ2c: Is the pattern consistent across the six partner institutions and the ten ESCO-aligned ICT qualification fields?

The pilot ran for one semester, from mid-January to mid-June 2025, at the six Ukrainian partner universities. Participation was embedded in regular course activity: students enrolled in pilot disciplines accessed the platform as part of their normal study load, and the testing constituted formative-assessment exercises within those courses. A total of 772 students completed at least one assessment over the semester, supported by 64 academic staff who authored test items, feedback blocks and remediation materials. Coverage across the partner institutions was uneven, reflecting the differing scale of the participating departments: 355 students at KhNU, 181 at KKNU, with the remaining 236 distributed in descending order across IFNUL, KSU, ONPU and KNU. The ten ESCO-aligned ICT professional qualification areas covered by the consortium were all represented, from Databases and Algorithmisation through Web Development, Data Analysis, Cybersecurity, Automation Technology and IT Project Management.

Two data sources were collected. The first, platform-generated, comprised the record of each test attempt: item-level responses, item-level correctness, total score on a 20-point scale, and the feedback block delivered. The second, survey-based, comprised two harmonised Google Forms instruments (one for students, one for teachers). There were distributed over a three-week window at the end of the semester. Combined response rates ranged from 42% to 71% across departments.

**An illustrative case.** Consider a student (referred to here as S-114) enrolled in a Data Analysis discipline mapped to ESCO field 2511.3 (Data analyst) at one partner university. The competency test comprised 20 single-correct multiple-choice items distributed across four skill clusters: data wrangling, descriptive statistics, SQL aggregation and querying, and visualisation. On the first attempt, S-114 scored 6/20 (below the 8/20 competency cut-off).

The item-level record showed competence concentrated in visualisation (4 of 5 items correct) but persistent failure in SQL aggregation (1 of 6) and descriptive statistics (1 of 5). The platform's competency-assessment module resolved this pattern to a low-band feedback block, which delivered a short remediation narrative naming the two weak clusters and prescribing foundational resources: an introductory relational-querying module and guided exercises on a hands-on practice platform.

On the second attempt, taken nine days later after the student engaged the prescribed material, S-114 scored 8/20, an Improvement Rate of 33% [(8 − 6) / 6 × 100], crossing the cut-off into demonstrated competency. The gains were localised to the two diagnosed clusters (SQL aggregation rose to 4 of 6), confirming that the lift tracked the remediation rather than general test familiarity. The third attempt reached 11/20 (IR 37.5%) and triggered a mid-band feedback block with project-based exercises; the fourth and fifth attempts reached 13/20 and 14/20 (IR 18.2% then 7.7%), the declining per-attempt gains characteristic of a curve approaching the upper scale. Plotted in the personalised-educational-diagram module, S-114's Improvement Curve is monotonically upward and crosses the cut-off at the second attempt – the joint signature of progression and attainment that the metric framework is designed to detect.

### *3.4.2 Findings: the Improvement Curve*

The principal finding is a consistent positive trajectory across repeated attempts. The Improvement Rate distribution between the first and second attempts spanned 9% to 38%, with a median of 17% across the full pilot population. The distribution is right-skewed: the modal student gained moderately, while a substantial sub-population – most evident among students whose first attempt fell well below the cut-off – gained more steeply. This is the pattern Black et al (1998) identified as the signature effect of well-designed formative feedback, with the strongest gains concentrated among lower-achieving students.

Trajectories beyond the second attempt are consistent with the same mechanism. Across students who attempted three, four or five times on the same competency-aligned test, the curve continued to trend upward, with declining per-attempt gains as the curve approached the upper end of the scale (Figure 1, Figure 2, Figure 3). Some five-attempt trajectories were non-monotonic, with a partial dip on the fourth attempt followed by recovery on the fifth; this is consistent with students attempting items in a more challenging configuration after exhausting the easier remediation resources. Second and subsequent attempts systematically crossed the platform's competency cut-off of approximately 8/20, which means students were not improving in the abstract but were moving into demonstrated competency on the assessed skill. Two questions are therefore answered simultaneously by the dataset: *is the student improving?* (trajectory analysis) and *has the student reached competency?* (threshold analysis). Both questions receive a positive answer across the pilot population.

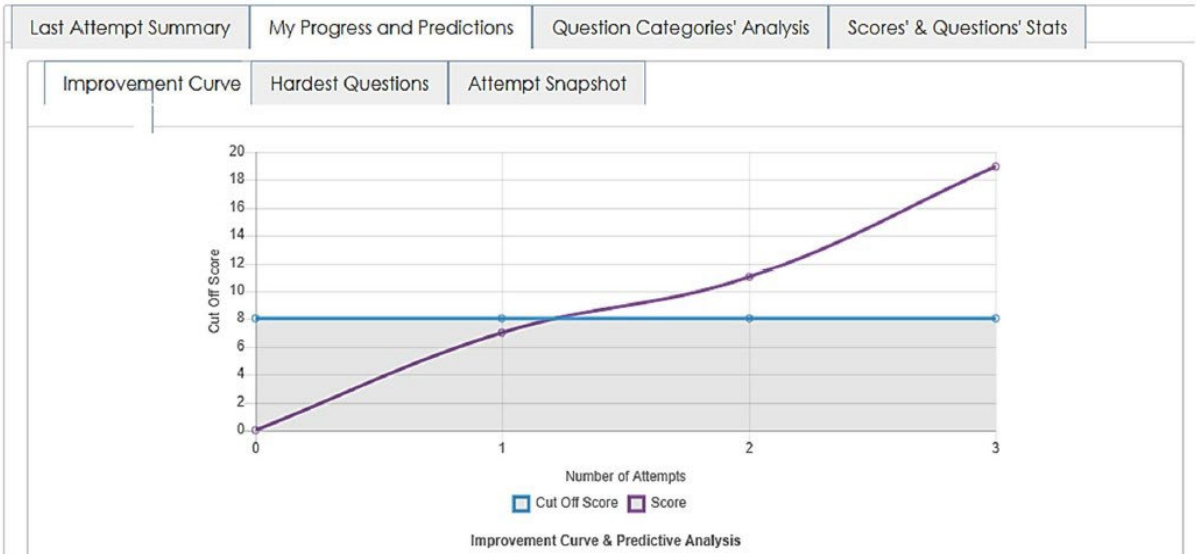



**Figure 1: Improvement Curve for 3-attempt students**

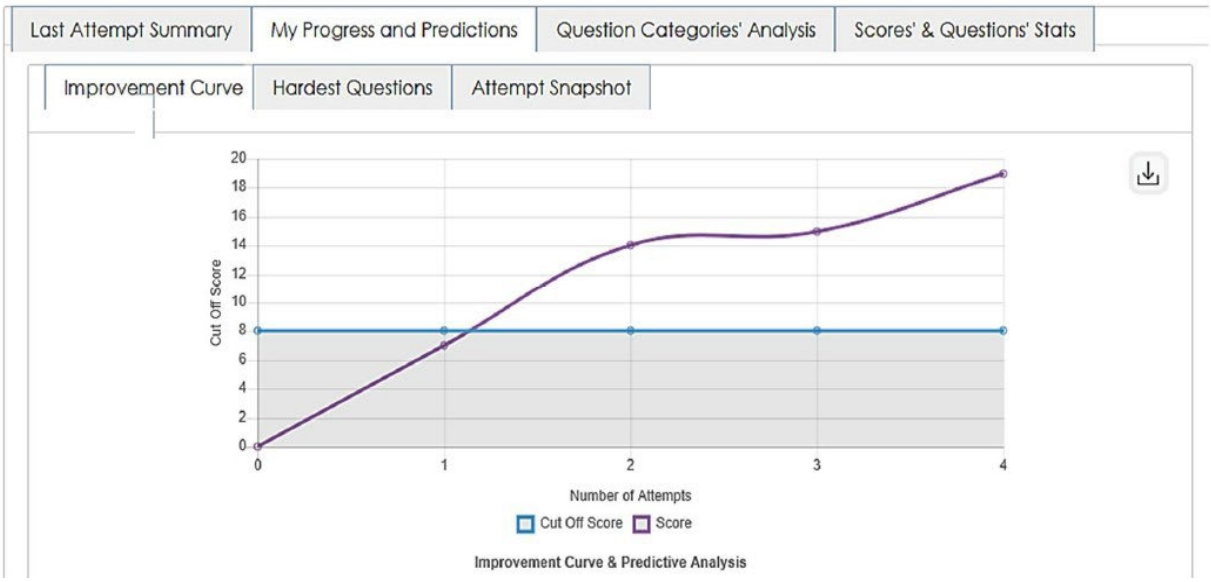



**Figure 2: Improvement Curve for 4-attempt students**

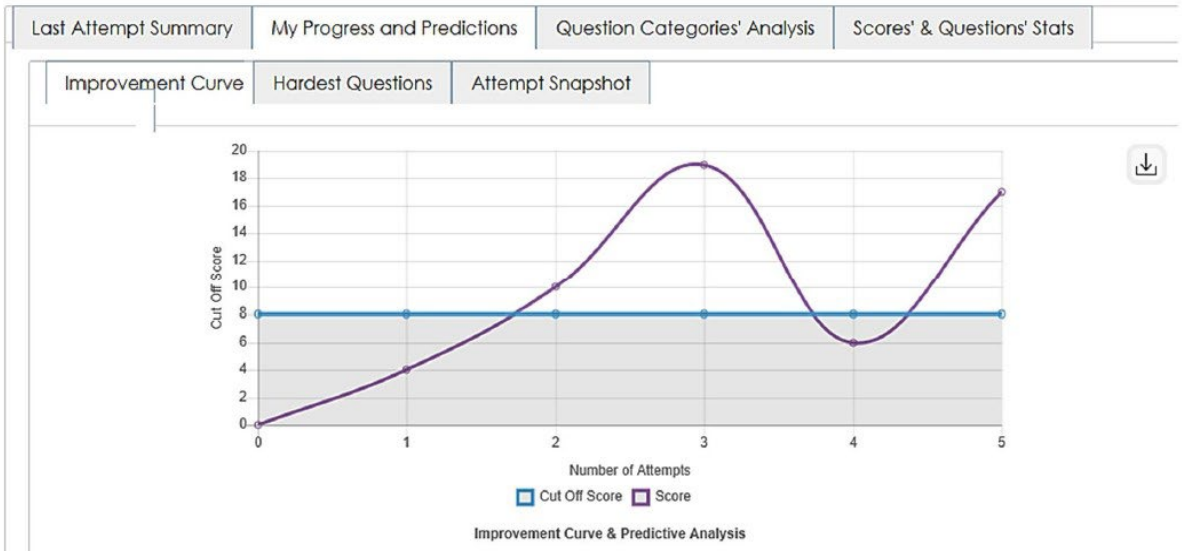



**Figure 3: Improvement Curve for 5-attempt students**

### *3.4.3 Survey Complement*

The student and teacher surveys provide a qualitative complement to the assessment data. Across the responding cohort, students reported that the diagnostic feedback was the platform's most valued feature: the linkage between an identified gap and a specific resource was experienced as a key benefit. Teachers reported that authoring feedback blocks alongside test items was effortful in the preparation phase but generated reusable assets and surfaced misconceptions in their own course content that had previously been invisible to them.

## 4. Discussion

### 4.1 What the Curve Does and Does not Show

As stated above, the improvement-curve evidence is consistent with the formative-feedback theory established by Black et al (1998, 2009) and Hattie et al (2007): when feedback is task-specific, addresses an identified gap, attainment rises; it rises most steeply for students who entered below the competency line. The 17% median gain across 772 students is robust to institutional setting and discipline area, and the threshold-crossing pattern

strengthens the reading: students are not just accumulating attempt-related score increments, but they are passing a criterion-referenced bar.

What the given design does not allow is a controlled comparison against a non-personalised counterfactual. There was no parallel control test receiving conventional formative assessment without diagnostic feedback, and there were no random allocation of students between conditions. Test-wiseness and item-familiarity effects on later attempts are not partialled out, although the use of a shuffled item bank and the platform's *Always latest attempt* setting mitigate the most obvious familiarity artefacts. The claim the paper makes is therefore modest: when a student receives system-generated feedback tied to identified gaps and re-engages with the prescribed remediation material, gains are large, consistent and replicable across six institutions, ten competence areas and all tested students. The paper does not claim that personalised learning outperformed traditional delivery in a counterfactual sense. It claims that the feedback loop produces measurable learning under the tested conditions.

### 4.2 Transferable Object

The transferable object of the SMART-PL project is the four-stage design pattern. The benchmarking-to-guidelines-to-metric-to-pilot sequence is repeatable in other higher education systems facing analogous pressures: an Eastern Partnership country negotiating EHEA alignment, a candidate country seeking to embed student-centred learning into accreditation procedures, a national system absorbing displaced or returning learners. The platform itself is open-source Moodle with documented configuration and a sharing policy that permits mirror instances; this lowers the transfer cost relative to a proprietary adaptive-learning vendor.

### 4.3 Limitations

Three limitations deserve to be stated in the paper. First, the pilot is single-domain: all ten ESCO areas are within information and communications technology and generalisation to other disciplinary clusters cannot be assumed without further evidence. Disciplines with less codifiable knowledge structures may respond differently to the closed-loop diagnostic-feedback mechanism that the SMART platform implements. Second, survey self-selection is a known confound on the 42–71% response rates: respondents may differ systematically from non-respondents on engagement with the platform, which is precisely the variable being measured. Third, the wartime context that makes the resilience finding interesting also constrains transferability: the inclusivity infrastructure that Ukrainian partners brought to the project predates SMART-PL and reflects national policy priorities that are not equally salient in other Eastern Partnership systems (Tsybuliak et al, 2024).

## 5. Conclusion

SMART-PL set out to design, build and empirically evaluate a personalised learning model fit for Ukrainian higher education in its current circumstances. The four-stage design – benchmarking, guidelines, metric framework, platform-mediated pilot – produced an artefact that survived the regulatory feasibility test imposed by Ukrainian programme accreditation procedures and an empirical evaluation that engaged 772 students and 64 academic staff across six universities and ten ESCO-aligned ICT qualification fields. The Improvement Curve evidence – a median gain of 17% between first and second attempts, with sustained upward trajectories across third, fourth and fifth attempts – is fully consistent with the formative-feedback theory established Hattie at al (2007).

The transferable contribution is the design pattern successfully developed by the project team. Other transitional higher education systems facing EHEA-alignment can adopt the four-stage sequence without recourse to proprietary adaptive-learning infrastructure: the SMART platform is open-source Moodle, the sharing policy permits mirror instances and the institutional anchoring achieved through rectorial orders embedding the Co-working Centres into permanent university structures is reproducible administrative practice. The methodological partnerships with NAQA and IHE NAESU that route consortium outputs into Ukraine's national quality-assurance architecture are likewise replicable through equivalent national bodies in other Eastern Partnership.

A causal-design follow-up pilot, with a parallel non-personalised comparator and randomised allocation, is required to extend the within-subject improvement evidence into a controlled effect estimate. Extension beyond ICT subject areas is needed before the model can be claimed as broadly transferable. And the second-iteration testing cycle scheduled for the spring 2026 semester will allow the consortium to test whether the

Spring 2025 effect is robust to changes in cohort composition, including a likely increase in the proportion of returning veterans and internally displaced students relative to the first cohort.

## Ethics Declaration

The pilot collected platform-generated assessment data (test attempts, item-level responses, scores, feedback delivery records) and survey responses from students and academic staff as part of regular course activity within the SMART-PL Erasmus+ CBHE project (Grant Agreement 101082928). Data collection followed each partner university's internal ethics and data-protection procedures and the consortium's sharing policy on access and authorisation. No personally identifiable information is reported in this paper or any project deliverables. The authors confirm that formal additional ethics clearance beyond routine pedagogical evaluation procedures was not required under the partner universities' research-ethics frameworks.

## AI Declaration

The authors used an AI tools in two roles during the preparation of this manuscript: for language proof-reading of the authors' drafted text and for the formatting of bibliographic references into the Harvard style, including the resolution of DOI identifiers.

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