Phlow Academy: Leveraging ICT for Scalable, Merit-Based Learning and Assessment Reform in Secondary Education

Paul Dunne
Phlow Academy / Independent Educational Designer & Engineer, Ireland

Abstract

This case study explores Phlow Academy, an Irish digital platform designed to modernise secondary education by using ICT for adaptive, merit-based progression. Grounded in theories of flow, mastery learning, and formative assessment, Phlow moves beyond traditional exams by embedding real-time feedback and personalised challenge directly into the learning process. Currently piloted with Junior Cycle Mathematics, the platform dynamically adjusts to each student's needs, fostering engagement and deeper understanding. By harnessing data-driven insights and learner-centred design, Phlow offers a scalable model that addresses long-standing issues in assessment and progression, illustrating how technology can drive meaningful educational reform.

1. Introduction

Phlow Academy is a digital-first learning and assessment platform that leverages information and communication technology (ICT) to modernise how secondary students in Ireland engage with the curriculum. It reimagines student progression not as a linear, time-based journey, but as a dynamic and merit-driven pathway shaped by individual readiness and understanding. Grounded in educational psychology and assessment theory, Phlow combines real-time feedback, scaffolded micro-learning, and adaptive digital infrastructure to offer a scalable alternative to high-stakes, end-of-cycle examinations.

The traditional Irish education system—particularly at the Junior and Leaving Certificate levels—relies heavily on terminal assessments to measure student achievement. While these exams provide standardised benchmarks, they often fail to capture the nuances of student learning and can disadvantage those who progress at different paces or require ongoing support [1,2]. Phlow addresses these systemic limitations by embedding formative assessment and mastery learning principles into the core structure of its platform. Rather than sorting students by performance at fixed intervals, it supports progression through continuous diagnostic feedback and demonstrated mastery.

In doing so, Phlow aligns with international calls for more flexible, personalised, and inclusive approaches to secondary education [3]. It also supports Ireland's national strategy for digital learning, which advocates for the integration of adaptive technologies that promote learner autonomy, data-informed teaching, and enhanced student engagement [1]. This case study explores how Phlow leverages ICT not merely as a content delivery tool, but as an engine for pedagogical reform—enabling new modes of assessment, real-time responsiveness, and merit-based advancement grounded in educational best practice.

2. Background and Theoretical Framework

Phlow Academy is built on well-established educational theories, each integrated into the platform's digital infrastructure to support effective, equitable, and scalable learning. These pedagogical foundations are not only relevant in research literature but also resonate with Ireland's curriculum reform agenda, particularly in the areas of learner autonomy, assessment for learning, and digital integration [1,2].

At the heart of the platform lies Flow Theory [4], which posits that optimal learning occurs when individuals are fully immersed in an activity where skill and challenge are well balanced. In the classroom, however, this state is difficult to achieve at scale, as instruction is typically geared towards an average level of ability. Phlow uses real-time learner data to dynamically adjust challenge levels, creating a personalised experience that keeps learners in a productive state of engagement—often described as "flow."

The platform is also grounded in Mastery Learning [5], which advocates for structured progression based on understanding rather than time spent. Rather than advancing all students through curriculum content at the same pace, mastery learning ensures that each learner has grasped a

concept before moving on. Phlow operationalises this by structuring each level as a micro-progression, where scaffolded steps, formative feedback, and intelligent prompting help the student succeed before introducing greater complexity.

Formative Assessment is another key pillar of Phlow's design. Research [6] shows that continuous, low-stakes assessment—particularly when combined with timely, actionable feedback—can significantly improve learning outcomes. Unlike traditional assessments that occur after instruction, Phlow makes assessment an embedded feature of every interaction. Each response (correct, incorrect, or skipped) is to be analysed in real time, and the system will respond accordingly to clarify misunderstandings or reinforce partial reasoning. This tight feedback loop helps cultivate metacognition and encourages self-regulated learning [7].

Unlike many conventional e-learning platforms that digitise static content, Phlow's architecture is designed to dynamically respond to learner behaviour. This allows the system to differentiate instruction based on real-time performance, supporting inclusive education by offering multiple, flexible pathways through the curriculum. Levels 4, 7, and 10 are specifically aligned with the Foundation, Ordinary, and Higher tiers of the Junior Cycle mathematics framework, respectively, providing a structured but adaptable system that scales with national standards [2]. All the levels in between are to ensure jumps up difficulty isn't too high.

Together, these theoretical foundations—flow, mastery, and formative assessment—inform a digital environment that supports deep learning, persistence, and learner agency. As ICT becomes more embedded in Irish classrooms, Phlow demonstrates how theory-led design can shape the next generation of digital learning tools in a way that is pedagogically sound and policy-aligned.

3. Case Study Description: The Phlow Academy Model

Phlow Academy was developed as a response to ongoing challenges in secondary education: inequitable progression, over-reliance on summative exams, and insufficient support for learners with diverse needs. Its digital infrastructure is designed to address these challenges through carefully structured content delivery, intelligent data use, and seamless feedback loops. The platform is currently in its early deployment phase, with Junior Cycle Foundation level Mathematics (Levels 1–4) fully developed and other levels and subjects in active development.

3.1. Platform Architecture and Content Delivery

Phlow Academy is built as a mobile-first application, reflecting the increasing prevalence of smartphone access among post-primary students in Ireland [8]. The app integrates a content engine and plans to have an analytics dashboard that works in real time to deliver personalised instruction. Content is structured into many scaffolded levels, with each level functioning as a "learning unit" consisting of:

3.1.1. Multi-step problem sequences. Multi-step problem sequences, designed to mirror the process of thinking through a problem rather than simply answering a question.

3.1.2. Interactive, touch-based elements. Interactive, touch-based elements, allowing learners to manipulate values, choose responses, and receive instant feedback.

3.1.3. Branching feedback. Branching feedback, which adjusts depending on the nature of the learner's response (e.g. common errors, partial reasoning, or skipped steps).

When learners select incorrect answers, they experience a brief red screen flash—a low-stakes alert that maintains momentum rather than penalising error. This aligns with research advocating for non-punitive, feedback-rich environments to support confidence and persistence [9].

3.2. ICT-Driven Level Progression and Data Use

Phlow's progression model is inspired by merit-based and mastery-aligned learning systems [10], where students advance by demonstrating understanding rather than meeting arbitrary deadlines. Each level contains 10 × level number questions (e.g., 30 in Level 3), and is algorithmically sequenced to gradually increase cognitive load [11]. Currently, all levels are 'unlocked' for everybody to use. In future developments, unlocking of topics at specific level difficulty is to be only available once ability is proven.

Planned data points include:

3.2.1. Error pattern analysis. Error pattern analysis, identifying misconceptions at specific steps.

3.2.2. Time-on-task tracking. Time-on-task tracking, to detect when students are rushing or struggling.

3.2.3. Completion rates. Completion rates, giving insight into where learners disengage or plateau.

3.2.4. Concept mastery indicators. Concept mastery indicators, tracking which ideas are secure or still emerging.

This data can feed into dashboards for teachers, researchers, or curriculum designers, supporting diagnostic teaching, targeted interventions, and system-level review. Teachers can use it to adapt

pacing or group students; researchers can analyse it for curriculum gaps; and students benefit from a "flow state" where challenge and skill are kept in equilibrium [12].

3.3. Feedback Loops and Future ICT Enhancements

Preliminary user testing has highlighted the importance of smooth transitions, intuitive navigation, and adaptive difficulty as key motivators for learners—consistent with broader literature on user experience in education technology [13].

Planned ICT enhancements include:

3.3.1. AI-driven diagnostics. AI-driven diagnostics, allowing real-time adaptation based on student responses, in line with research into intelligent tutoring systems [14].

3.3.2. AR-based handwriting recognition. AR-based handwriting recognition, enabling the app to process real, handwritten student work for feedback—especially valuable in Maths and Science.

3.3.3. Voice interaction tools. Voice interaction tools, enabling learners to "talk through" concepts with an AI conversational partner. Depending on user settings, the AI could be passive, Socratic, or directive—encouraging learners to explore, explain, and reflect [15].

3.3.4. ChatGPT-style prompting. ChatGBT-stlye prompting, enabling text interactions that allow students to ask specific questions about the problem they are working on. Keeping the AI use of the student 'in-house' discourages them from using external sources to cheat. The use would also form part of the AI-driven diagnostics.

These future features aim to extend Phlow's capabilities beyond simple question-answer feedback into multi-modal interaction, capturing a fuller range of learner inputs, including speech, gesture, and process-based reasoning.

4. Discussion: ICT as a Catalyst for Assessment Reform

The traditional assessment model in Irish secondary education continues to rely heavily on high-stakes, summative examinations, such as the Junior Cycle and Leaving Certificate, which often occur at fixed points in time and emphasise recall over process [16]. While these assessments provide a snapshot of student performance, they do not always offer a complete picture of learning, progress, or capability—particularly for students who learn in non-linear ways or who experience test anxiety [17].

Phlow Academy presents an alternative paradigm, using ICT not simply to digitise learning content, but to reposition assessment as a formative, continuous, and integrated part of the learning process. The platform's data-driven architecture enables real-time feedback, which has been shown to improve student motivation and understanding when compared to delayed or one-time assessments [18]. Each interaction—whether successful or mistaken—becomes a moment of reflection and adaptation, transforming assessment into diagnosis and guidance rather than judgement.

By using data analytics, Phlow moves toward what Clarke [19] calls "assessment for learning", where every user action informs future learning opportunities. Learners receive low-stakes feedback (e.g. colour-coded visual cues, hints, scaffolds) that supports self-regulation and growth. This environment promotes student agency, allowing individuals to progress at their own pace, repeat material as needed, and build mastery before moving forward—qualities which are critical to equity in education [20].

Moreover, Phlow's integration of levelled difficulty and adaptive progression supports ungrading and differentiation, challenging the one-size-fits-all logic of traditional classes. In this way, the system creates space for students to experience the "flow state" described by Csikszentmihalyi [4], where learning is neither too easy nor overwhelming, but optimally matched to current ability.

In the Irish context, this innovation aligns with policy developments such as the Digital Strategy for Schools to 2027 [21], which emphasises learner-centred approaches and the use of data for formative assessment. It also responds to the National Council for Curriculum and Assessment's (NCCA) calls for more flexible and personalised pathways through education.

While platforms like Phlow do not replace the need for summative assessment entirely, they redefine its role—positioning exams as one of many validation tools rather than the sole arbiter of success. This shift could have profound implications for educational inclusion, progression, and credentialing, particularly if scaled nationally or regionally.

5. Conclusion

Phlow Academy offers a working model for how digital innovation can be leveraged to transform assessment and progression in secondary education. Unlike traditional systems that rely on time-based advancement and high-stakes terminal exams, Phlow integrates real-time data, formative assessment, and adaptive feedback into a coherent, learner-driven framework. This aligns with growing international consensus on the need for more equitable, personalised, and evidence-informed learning pathways [22].

By embedding psychological and pedagogical theories—such as Flow Theory [4], Mastery Learning [5], and Formative Assessment [6]—into its technical architecture, the platform reimagines how students engage with curriculum. It shows how ICT can create conditions for intrinsic motivation, cognitive challenge, and self-regulation, which are central to long-term academic growth [7].

Crucially, Phlow does not frame ICT as a supplementary tool, but as a core infrastructure for progression, monitoring, and differentiation. The system's design offers a possible alternative to the dominant logic of linear, time-bound, and exam-centric schooling. Instead, it fosters an ecosystem where mastery, not seat time, is the currency of advancement—a shift that could radically enhance inclusion and opportunity across Ireland's post-primary sector.

Furthermore, the project responds directly to Ireland's national Digital Strategy for Schools 2027 [21]. By offering scalable, curriculum-aligned learning experiences with embedded assessment, Phlow provides a testbed for 21st-century educational policy reform.

In the coming years, platforms like Phlow could inform the development of alternative credentials, modular progression systems, or even replacements for final state exams—provided robust policy frameworks and institutional support are in place. For now, Phlow Academy represents a bold and practical example of how ICT can shift the educational centre of gravity from testing towards learning, and from sorting to supporting.

10. References

[1] DES (Department of Education and Skills),. *Digital Strategy for Schools 2015–2020: Enhancing Teaching, Learning and Assessment*. Dublin: Government of Ireland, 2015

[2] NCCA (National Council for Curriculum and Assessment). *Junior Cycle Framework*. Dublin: NCCA, 2020

[3] OECD. *Back to the Future of Education: Four OECD Scenarios for Schooling*. Paris: OECD Publishing, 2020

[4] Csikszentmihalyi, M., *Flow: The Psychology of Optimal Experience*, Harper & Row, 1990

[5] Bloom, B. S., *Learning for Mastery*, UCLA Evaluation Comment, 1968

[6] Black, P., & Wiliam, D., *Inside the Black Box: Raising Standards Through Classroom Assessment*, Phi Delta Kappan, 1998

[7] Zimmerman, B. J. *Becoming a self-regulated learner: An overview. Theory Into Practice*, 41(2), 64–70, 2002

[8] O'Leary, M. and Scully, D. *Digital Learning in Irish Post-Primary Schools: Access, Use and Equity*. Dublin: ERSI, 2022

[9] Nicol, D. and Macfarlane‐Dick, D. Formative Assessment and Self‐Regulated Learning: A Model and Seven Principles of Good Feedback Practice. *Studies in Higher Education*, 31(2), pp.199–218, 2006

[10] Guskey, T.R.. *Lessons of Mastery Learning*. Educational Leadership, 68(2), pp.52–57, 2010

[11] Sweller, J., Ayres, P. and Kalyuga, S. *Cognitive Load Theory*. New York: Springer, 2011

[12] Shernoff, D.J., Csikszentmihalyi, M., Schneider, B. and Shernoff, E.S. Student Engagement in High School Classrooms from the Perspective of Flow Theory. *School Psychology Quarterly*, 18(2), pp.158–176, 2003

[13] Uosaki, N., Ogata, H., Mouri, K., Liu, Y. and Hou, B.. An Automatic Detection of Learners' Confusion Using Machine Learning. *International Journal of Mobile Learning and Organisation*, 7(2), pp.115–133, 2013

[14] VanLehn, K. The Relative Effectiveness of Human Tutoring, Intelligent Tutoring Systems, and Other Tutoring Systems. *Educational Psychologist*, 46(4), pp.197–221., 2011

[15] Mercer, N. and Dawes, L. The Dialogic Classroom: Talking to Learn in Science Classrooms. *Learning, Culture and Social Interaction*, 3(1), pp.12–17., 2014

[16] Hyland, Á., 2011. *Entry to Higher Education in Ireland in the 21st Century*. Dublin: NCCA.

[17] Smyth, E. *Off to a Good Start? Primary School Experiences and the Transition to Second-Level Education*. Dublin: ESRI., 2017.

[18] Shute, V.J. Focus on Formative Feedback. *Review of Educational Research*, 78(1), pp.153–189., 2008.

[19] Clarke, S., 2012. *Active Learning through Formative Assessment*. London: Hodder Education.

[20] OECD *Student Agency for 2030: Learning Compass Brief*. Paris: OECD Publishing, 2020.

[21] Department of Education (DES) *Digital Strategy for Schools to 2027*. Dublin: Government of Ireland., 2022.

[22] National Council for Curriculum and Assessment (NCCA), 2019. Senior Cycle Review: Consultation Report. Dublin: NCCA.