

Simplifying Gamification in Practice: A Design Model for Training Transfer-oriented Industrial Learning

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Abstract: Gamification has become one of the most sought-after strategies to enhance learners' engagement and motivation, especially in digital learning environments. Within the organisational and industrial training context, the adoption of gamification has expanded, with Learning Management Systems (LMS) serving as a primary vehicle for workforce development. Industry 5.0 requires integration with cyber-physical systems, Artificial Intelligence (AI) and human-centred production principles that impose a continuous increase on workers for upskilling and reskilling. Nevertheless, a gap exists between the potential of gamification and what most implementations deliver. The main challenge is that, in the industrial LMS context, gamification is often driven more by platform accessibility than by instructional design. Game mechanics such as points, badges, and leaderboards are widely used for their availability rather than for their effect on the cognitive processes required to achieve learning objectives. The availability-driven approach can initially generate engagement, but it becomes more challenging to achieve Training transfer (TT) of competencies in industrial training, especially given the heterogeneity of industrial workers across experience, digital literacy, and motivational orientation, making a unified configuration unfeasible to sustain across the learners' population. Compounding those challenges are the architectural constraints of existing LMS platforms, which might limit the consolidation of behavioural data across gamified components. This study introduces the SIGAT-IL Model (Scalable, Iterative, Gamification, Adaptive, Transfer, Industrial Learning) as a structured design framework to address those implementation challenges. Through a structured synthesis of current literature and established theoretical frameworks, the study identifies four implementation challenges: technological constraints, pedagogical-technical misalignment, learner heterogeneity, and scalability limitations, and proposes corresponding design principles. This model is centred around five established theoretical frameworks: Self-Determination Theory (SDT), Cognitive Load Theory (CLT), the Mechanics-Dynamics-Aesthetics (MDA) framework, the TT framework and the adaptive learning paradigm. The model does not prescribe a fixed configuration; it offers coherent, interconnected design principles that streamline implementation decisions and support contextually appropriate outcomes. The model repositions TT, defined as the generalisation and maintenance of trained skills in the operational workplace, as the primary criterion for evaluating gamification design choices, shifting focus from engagement metrics towards evidence of meaningful applied learning. The study concludes that repositioning TT as the primary evaluative criterion, rather than engagement metrics alone, is the essential shift required for more effective industrial gamification. These findings point to the need for longitudinal empirical validation of the model in operational industrial settings and comparative studies of structural, content and hybrid gamification configurations.

Keywords: SIGAT-IL model, Gamification, Industry 5.0, Training transfer, Workforce training, Adaptive learning, Industrial learning

1. Introduction

Industry 5.0, defined by the integration of cyber-physical systems, AI and human-centred production principles has transformed the workforce development from a periodic activity to a continuous operational priority (European Commission, 2021). Workers must now master new technologies, adapt to evolving procedures and build digital competencies that were not part of their original training (Longo, Padovano and Umbrello, 2020). Traditional instructor-led training is unable to match the pace or diversity of the required training, primarily due to fixed schedules and uniform content delivery (Knowles, Holton and Swanson, 2006). LMS platforms have become the preferred infrastructure for industrial training at scale, and gamification has increasingly attracted institutional interest as a strategy for enhancing engagement and improving learning outcomes within these platforms.

The Deloitte Leadership Academy reported improvements in completion rates and learner satisfaction through gamification (Joy, 2018). The Italian National Recovery and Resilience Plan (PNRR) has explicitly mandated scalable digital methodologies within its funded programmes (Governo Italiano, 2021). Research has confirmed that well-structured gamified learning environments can enhance intrinsic motivation and outperform non-gamified alternatives (Hamari, Koivisto and Sarsa, 2014). Yet the evidence is inconsistent: elements that work well in one deployment can yield limited or mixed outcomes in another (Hanus and Fox, 2015). These inconsistencies reflect design and implementation challenges rather than limitations of gamification itself.

A central challenge is that game elements are usually selected based on platform availability, rather than on what is required for specific learning objectives. Consequently, implementations prioritise engagement over transferable competencies that industrial training ultimately dictates. This research presents the SIGAT-IL Model as a structured design framework to address these implementation challenges. It offers training designers and educators a theoretically grounded orientation for implementation decisions within existing LMS infrastructure

TT is defined as the generalisation and maintenance of trained skills in the operational workplace (Baldwin and Ford, 1988) and serves as the primary benchmark for evaluating implementation quality. (Baldwin and Ford, 1988) distinguished between near transfer, applying learned skills to tasks resembling training conditions, and far transfer, applying underlying principles to situations not encountered during training. Industry 5.0 environments require both near and far transfer. This distinction has direct consequences for how gamification must be designed.

2. Theoretical Grounding and Implementation Complexity

Effective gamified learning design goes beyond selecting available game elements and adding them to a platform. Understanding the principles by which motivation, cognition, and instructional design interact, and the architectural constraints that limit their application in practice is essential to effective design.

2.1 Effective Gamification Requirements

SDT, developed by Deci and Ryan (2000), identifies autonomy, competence and relatedness as the core psychological needs whose satisfaction sustains intrinsic motivation. This means mechanics must be selected not only for motivational appeal but for whether they genuinely support these needs across a diverse workforce. Leaderboards, for instance, might reinforce perceptions of competence among high-performing workers while simultaneously undermining the sense of belonging and autonomy among those who usually rank lower (Hanus and Fox, 2015). SDT's sub-framework, Organismic Integration Theory, adds that gamification that predominantly relies on extrinsic rewards tends to produce externally regulated engagement.

Cognitive Load Theory (CLT) adds a further design constraint (Sweller, 1988). The learner's working memory is limited, so instructional design that imposes demands unrelated to the learning objective reduces the mental capacity available for knowledge construction, a phenomenon known as extraneous cognitive load. Game elements added as overlays to content not originally designed to accommodate them risk generating extraneous load, shifting attention from the material to the interface (Hawllitschek and Joeckel, 2017). The Mechanics-Dynamics-Aesthetics (MDA) framework developed by Hunicke, LeBlanc and Zubek (2004) traces how mechanics generate behavioural dynamics within players that, in turn, produce experiential aesthetics. A mechanic that triggers anxiety rather than challenge or compliance rather than active exploration, fails at the dynamics level and undermines the learning experience, regardless of its technical implementation.

2.2 The Structural-content Distinction

A distinction that rarely receives sufficient attention in implementation decisions is that between structural and content gamification (Kapp, 2012; Filatro and Cavalcanti, 2016). Structural gamification applies game mechanics such as points, badges, leaderboard and progress indications, around existing content without altering it. Content gamification integrates game logic directly into the learning experience, embedding branching narratives, scenario-based simulation, and decision-consequence activities (Dicheva, *et al.*, 2015).

Structural gamification predominates in current LMS deployments because they require no instructional redesign as plugins make them immediately accessible (Kapp, 2012; Filatro and Cavalcanti, 2016). However, their motivational impact is often temporary. As SDT predict, external rewards drive initial participation but lose their effect once novelty fades.

In contrast, content gamification produces more durable results because it changes what learners actually do with the material (Kapp, 2012; Seaborn and Fels, 2015). Scenario-based tasks require learners to apply

knowledge, make decisions and observe consequences. Baldwin and Ford (1988) identify this pattern of varied practice and error-informed reasoning, that is, adjusting judgement based on observed mistakes, as central to far TT, the form most demanded by Industry 5.0 operational environments. Branching narratives build the mental models needed for performance in situations the training did not directly cover (Blume *et al.*, 2010). A hybrid approach using content gamification as the instructional core with structural mechanics as scaffolding, is best suited to industrial training (Kapp, Blair and Mesch, 2014).

2.3 Platform Constraints and Learner Diversity

LMS platform architecture creates its own constraints. Major platforms such as Moodle, Docebo and TalentLMS offer extensive gamification capability through native features and third-party plugins (Mustafa *et al.*, 2023). However, a recurring limitation is that this plugin ecosystem was not built for data integration. Each plugin typically maintains its own data model, so the behavioural signals adaptive gamification depends on, including error patterns, response latencies and decision quality within branching scenarios, are rarely consolidated across activities (Hallifax, 2020; Uwakwe Udeh *et al.*, 2025). What platform captures is surface engagement: completion events, badge awards and accumulated points. This data is of limited diagnostic value for evaluating whether training is producing transferable competencies (Subhash and Cudney, 2018).

Learner diversity adds further complexity. Workers differ meaningfully in prior experience, digital literacy, motivational orientation, and preferred engagement styles (Knowles, Holton and Swanson, 2006; Illeris, 2010). Research using the Hexad player-type framework demonstrates that different learner profiles respond optimally to different gamification mechanics: achiever types are energised by challenge and progression; socialiser types require collaborative structures; free-spirit learners disengage when overly constrained (Tondello *et al.*, 2016). Yet a uniform gamification configuration is unlikely to serve all of these profiles equally effectively. Because learner states also evolve as training progresses, static enrolment profiles quickly become unreliable, and real-time learning analytics are needed to keep configuration aligned with where each learner actually is (Che Hassan, Wan Shamsuddin and Yusof, 2022).

3. The SIGAT-IL Model: A Framework for Practical Implementation

The implementation challenges outlined above share a common thread: they stem not from a lack of available tools, but from a lack of structured guidance for using those tools in service of the learning objective. Educators and training designers in industrial LMS environments often have access to capable platforms and a range of gamification mechanics. What they less commonly have is a coherent decision framework that specifies which mechanics to prioritise, how to sequence their introduction, and how to evaluate whether the choices they have made are producing the intended outcome.

The SIGAT-IL Model (Scalable, Iterative, Gamification, Adaptive, Transfer, Industrial Learning) is proposed as a practical response to that need. It is a structured design orientation that supports implementation decisions in a theoretically grounded, contextually sensitive way, with TT as the consistent evaluative criterion throughout. Figure 1 maps the SIGAT-IL Model's structure, illustrating the four implementation challenges and their corresponding design principles within the industrial learning context.

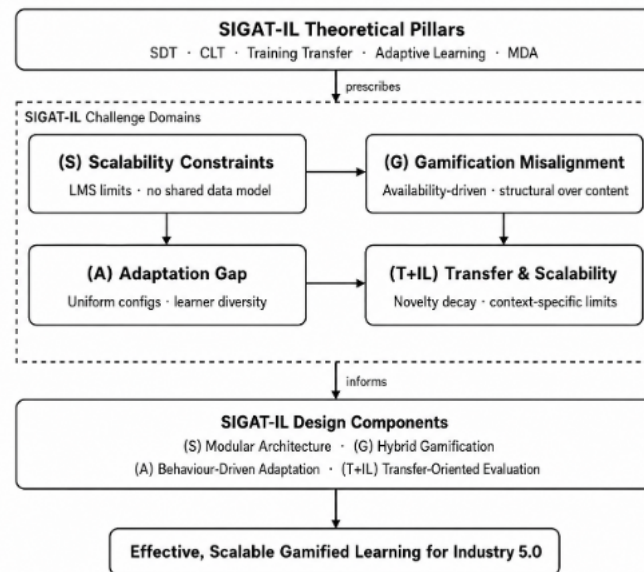


Figure 1: Theory-to-practice gap: four interconnected implementation challenge domains and corresponding design considerations (Generated using ChatGPT, OpenAI, 2026)

3.1 A Transfer-centred Design Philosophy

The SIGAT-IL Model is founded on a fundamental reorientation of the evaluation criterion against which gamification in industrial training should be assessed. Both the prevailing literature and current professional practice tend to evaluate gamification success predominantly through engagement metrics. Completion rates, login frequency and badge accumulation. While such indicators offer a useful measure of participation, they provide limited evidence of actual training effectiveness in the industrial contexts. The real question is whether the skills and knowledge acquired during training generalise to the workplace and are sustained in operational performance over time. This is precisely what (Baldwin and Ford, 1988) define as TT, which the SIGAT-IL Model adopts as the central evaluative criterion informing every design decision.

This reorientation carries direct implications for design practice, as mechanic selection should not be driven by platform accessibility or immediate motivational appeal, but by the degree to which a given mechanic activates the cognitive processes that TT demands, including varied practice, error-informed reasoning and the construction of flexible mental models applicable to operational situations beyond those directly encountered in training (Blume *et al.*, 2010). Content gamification, which redesigns the instructional material itself through scenario-based simulations, branching narratives, and decision-consequence activities, is better positioned to activate these processes than structural gamification, which applies game mechanics as a motivational overlay without altering the underlying content. The SIGAT-IL Model does not prescribe a uniform approach; it advocates a hybrid design in which content gamification serves as the instructional core, with structural mechanics providing motivational scaffolding and orientation, particularly in the early phases of engagement, before intrinsic motivation has had a chance to consolidate (Deci and Ryan, 2000).

3.2 Infrastructure, Adaptivity and Learner-Centred Design

Effective implementation requires more than a sound design philosophy; it requires the right architectural components for that philosophy to operate. Therefore, the SIGAT-IL Model prioritises scalable, modular infrastructure as a foundation for all other design decisions. In practical terms, this requires designing gamification components as distinct, interconnected elements that communicate through standardised data interfaces, allowing individual components to be modified or extended without compromising the integrity of the wider system (Elkady *et al.*, 2025). This modularity allows the organisation to begin with what their existing infrastructure can support and progressively extend capabilities as evidence accumulates and confidence grows. It also creates the data conditions necessary for genuine adaptivity, whereby shared access to a common data layer across gamification components makes behavioural signals available for analysis, including error recovery patterns, response latencies, and decision quality in branching scenarios, rather than leaving them siloed within independently operating components (Hallifax, 2020; Uwakwe Udeh *et al.*, 2025).

Adaptivity is not a peripheral feature of the SIGAT-IL Model; it is central to its response to learner heterogeneity. The industrial workforce is not homogeneous, and research consistently demonstrates that different learner profiles respond optimally to different gamification mechanics (Tondello *et al.*, 2016). A static enrolment profile collected at the beginning of a training programme offers limited guidance as learners progress, accumulate experience, and shift in their motivational orientation. The Model therefore specifies a behaviour-driven approach to adaptation, whereby gamification configurations are continuously refined in response to observed learner behaviour rather than remaining fixed to initial enrolment characteristics alone. The system monitors ongoing engagement signals, including task completion patterns, error frequencies, and indicators of cognitive overload or disengagement, and adjusts the balance between structural and content gamification accordingly. Workers demonstrating strong performance are progressively exposed to increasingly open-ended content-gamification scenarios; those encountering difficulty are redirected to more structured pathways with greater motivational scaffolding. (Hallifax, 2020) demonstrated, within a standard Moodle environment, that combining static and dynamic adaptation produced measurably stronger learning outcomes than a uniform configuration, without requiring specialist infrastructure. Figure 2 illustrates this adaptive cycle, showing how behavioural signals captured during training drive iterative adjustments to the structural-content gamification balance, with TT outcomes feeding back into subsequent deployment cycles.

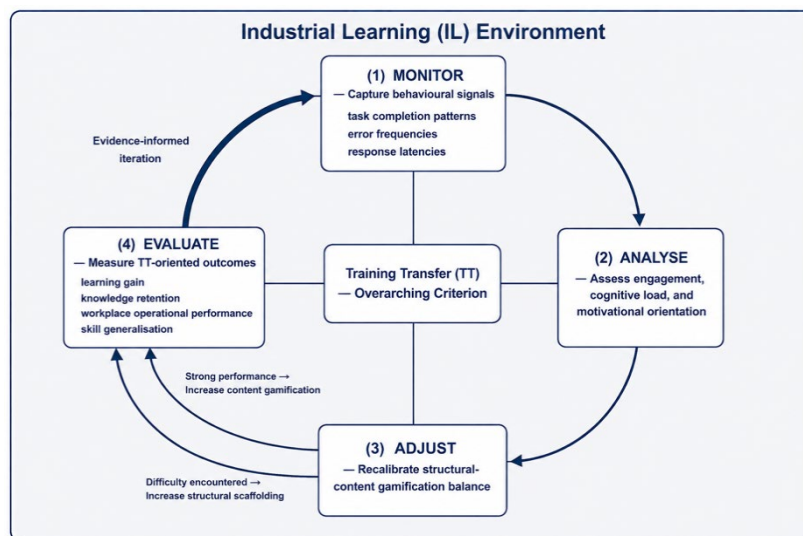


Figure 2: The SIGAT-IL Adaptive Feedback Loop, depicting a continuous cycle of monitoring, analysis, adjustment, and transfer-oriented evaluation within the Industrial Learning (IL) environment (Generated using ChatGPT, OpenAI, 2026)

3.3 Evaluation as an Ongoing Design Practice

The final dimension of the SIGAT-IL Model concerns how implementations are evaluated and sustained over time. Current practice tends to treat evaluation as a terminal activity, in which outcomes are measured at the point of training completion, and the system remains largely unchanged until a formal review cycle prompts reconsideration. The SIGAT-IL Model proposes a different approach, one in which evaluation is embedded within the design process as a continuous iterative practice rather than positioned as a concluding checkpoint external to it. Operationally, this requires extending the evaluative scope beyond completion rates and engagement indicators to encompass four TT-oriented outcome measures: learning gain at the point of training completion, knowledge retention assessed at post-training intervals, observed improvement in workplace operational performance, and the degree to which acquired skills generalise to novel situations not directly addressed within the training programme (Baldwin and Ford, 1988; Blume *et al.*, 2010).

In a hybrid implementation that integrates structural and content gamification, evaluation should also assess the relative contribution of each approach to TT outcomes, thereby generating the empirical evidence needed to systematically refine the balance between them across successive deployment cycles. Content gamification scenarios require periodic renewal to remain aligned with the current operational context and evolving technology, which manages novelty decay without reverting to the limited long-term motivational sustainability of purely reward-based structural mechanics (Triantafyllou, Georgiadis and Sapounidis, 2025). Table 1 summarises the model's structure, mapping each implementation challenge to its corresponding design principle and the TT criterion it is intended to serve.

Table 1: The SIGAT-IL Model: implementation challenges and design principles

Implementation challenge	Design principle	Operational focus	TT criterion
Technological constraints (LMS architecture)	Scalable modular infrastructure	Interoperable components with unified data interfaces capturing behavioural signals beyond completion events	TT readiness
Pedagogical-technical misalignment (availability-driven selection)	Hybrid content-structural gamification	Content gamification as instructional core; structural mechanics as motivational scaffolding; MDA/SDT selection logic	Far transfer activation
Learner heterogeneity (uniform configurations)	Behaviour-driven adaptive design	Real-time monitoring of engagement and cognitive signals; dynamic structural-content balance adjustment	Individual transfer alignment
Scalability and novelty decay	TT-oriented iterative evaluation	Learning gain, retention, and workplace performance metrics; evidence-based content renewal	Population-specific transfer evidence
<i>All four design principles are situated within the Industrial Learning (IL) context. TT from the digital training environment to the industrial workplace is the overarching criterion against which the SIGAT-IL Model is evaluated.</i>			

4. Discussion

The implementation challenges identified in this study are not straightforward to overcome. Architectural constraints within LMS platforms, workforce heterogeneity, and availability-driven design decisions are deeply embedded features of the current landscape, not surface-level problems any single framework can fully resolve. The SIGAT-IL Model's distinctive contribution lies in integrating architectural, pedagogical, adaptive and evaluative dimensions into a coherent orientation anchored to TT, rather than treating each as a separate design concern (Kapp, 2012; Hallifax, 2020). What the model offers is a structured set of principles that help educators and training designers navigate these complexities with greater clarity than current practice typically affords.

Among the most practically significant contributions of the SIGAT-IL Model is the explicit repositioning of Training Transfer (TT) as the primary evaluative criterion against which gamification implementation should be assessed. In many industrial training contexts, gamification success is currently determined by the metrics that platforms make most readily available, predominantly completion rates, login frequency and badge accumulation, none of which provide sufficient evidence of whether training has produced operationally transferable competence. When TT becomes the organising criterion, the design question shifts from platform capability to learning intent. Rather than asking which mechanism a specific platform supports, educators and training designers are guided to ask which cognitive processes a specific learning objective requires, and which design choices are most likely to activate them. This transition from availability-driven to objective-driven selection logic represents the central practical contribution of the SIGAT-IL Model, offering educators a more structured and theoretically grounded basis for implementation decisions. This shift matters because it changes the standard against which implementation quality is judged, not just the mechanics used to achieve it.

The structural-content distinction is where this shift becomes most visible in practice. The predominance of structural gamification reflects a practical reality: embedding simulations or branching narratives demands considerably greater instructional design investment than adding badge systems or leaderboards to existing content, and organisations must balance pedagogical ambition with available resources. The SIGAT-IL Model is designed with this reality in mind. Consistent with existing evidence supporting hybrid gamification design (Kapp, 2012; Filatro and Cavalcanti, 2016), the model advocates for an orientation in which the role of content gamification expands progressively as organisational capability, infrastructure and evaluative evidence develop over time, with structural mechanics continuing to serve as motivational scaffolding throughout. This incremental framing supports progress towards more TT-oriented gamification design at a pace that is realistic and sustainable given each organisation's current circumstances.

The adaptive dimension of the SIGAT-IL Model addresses one of the more persistent challenges within current platform architectures: the tension between the diversity of industrial learners and the uniformity of most gamification configurations. Research demonstrates that transfer gains are most susceptible to decay when individual learner characteristics, group dynamics and organisational support conditions are misaligned, a pattern that characterises many standard uniform deployments (Uwakwe Udeh *et al.*, 2025). Addressing this tension within existing LMS architectures remains inherently complex, and the SIGAT-IL Model does not claim to resolve it entirely. Rather, consistent with the adaptive learning approaches documented in the literature (Hallifax, 2020; Che Hassan, Wan Shamsuddin and Yusof, 2022), it provides a structured mechanism for responding to learner diversity progressively, as accumulated behavioural data replaces initial assumptions about learner needs with evidence-informed insight.

4.1 Future Directions

The SIGAT-IL Model highlights three areas where the empirical evidence base would benefit from further development. First, the field would be strengthened by longitudinal studies that track TT in operational settings over extended periods, rather than measuring outcomes only at the point of training completion. Second, there is a notable absence of robust comparative studies examining the relative effects of structural, content and hybrid gamification configuration within the same industrial worker population and operational domain. Third, the multilevel TT framework of (Uwakwe Udeh *et al.*, 2025) and the foundational TT model of (Baldwin and Ford, 1988) have not yet been applied jointly in empirical industrial gamification research, representing a theoretical integration that warrants dedicated empirical investigation. These gaps are not specific to the present study; they reflect broader limitations in the literature that future research programmes would productively address.

4.2 Limitation

The SIGAT-IL Model is grounded in theoretical synthesis and structured reasoning drawn from established literature rather than direct experimental validation; therefore, its propositions require empirical testing in real industrial training contexts before definitive conclusions can be drawn. Additionally, the model draws on evidence from across a range of LMS platforms and industrial sectors but does not fully account for context-specific conditions that may affect its applicability in particular settings. Furthermore, its focus on adult learners in industrial and/or organisational contexts means that its relevance to other educational settings, such as formal higher education or secondary education, should not be assumed and would require separate investigation. Despite these limitations, the SIGAT-IL Model offers practical value as a structured starting point for training designers seeking to move beyond availability-driven gamification, and as a theoretical foundation for empirical studies examining TT outcomes in industrial LMS contexts.

5. Conclusion

Gamification holds genuine promise for industrial workforce training but realising that promise consistently and at scale requires more than familiarity with game mechanics or access to capable platforms. It requires a structured approach to design, one that connects game element selection to the cognitive processes meaningful learning depends on and evaluates implementation success against a single criterion: whether acquired skills and TT are applied where they are needed most.

This study has argued that the gap between gamification's theoretical potential and its practical outcome in the industrial LMS context is largely a question of design logic. When selection decisions are driven by platform accessibility rather than instructional intent, when structural mechanics are applied uniformly across diverse workforces without adaptive responsiveness and when success is measured by participation data rather than TT evidence, the conditions for sustained learning are unlikely to be met regardless of the sophistication of the platform infrastructure. The SIGAT-IL Model is proposed as a practical design orientation to address these implementation challenges in a structured, theoretically grounded way. By positioning TT at the centre of implementation decisions, advocating for a hybrid approach combining content and structural gamification in a contextually responsive manner, and embedding iterative evaluation as a continuous practice, the model offers educators and training designers a more coherent implementation basis. This clarification represents a constructive step forward for a field in which implementation decisions have not always been guided by explicit pedagogical criteria. The study's key findings centre on four implementation challenges and four corresponding design principles, together forming a framework that redefines how gamification effectiveness in industrial training should be measured.

Looking ahead, the SIGAT-IL Model provides a theoretical foundation for empirical work that the field would benefit from, longitudinal studies tracking TT in operational settings over time; comparative evaluations of

structural, content, and hybrid gamification configurations within the same industrial population and context-sensitive investigation of adaptive design across diverse industrial sectors. As that evidence base develops, the model's design principles can be refined and calibrated to specific implementation contexts. The broader aim of this study is not a definitive or universal solution, but a more informed, deliberate and pedagogically grounded approach to gamified learning in industrial training contexts. The SIGAT-IL Model is directly applicable to training designers planning LMS-based gamification in manufacturing and industrial settings, to LMS developers considering data architecture decisions, and to researchers designing empirical studies of gamification effectiveness in industrial contexts.

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AI Declaration: AI tools were used in preparing this study. ChatGPT was used for brainstorming; Gemini for organising ideas; Claude (Anthropic) for structural organisation and summarisation; Semantic Scholar and Google Scholar for literature identification; Grammarly and Paperpal for proofreading; Zotero for reference management. Intellectual content and academic responsibility remain solely with the authors. Generative AI (ChatGPT, OpenAI) was used to generate schematics for Figure 1 (15 April 2026) and Figure 2 (5 August 2026) based on author-defined parameters. Conceptual frameworks and final verification were conducted entirely by the authors.

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