



Journal of Advanced Research in Social and Behavioural Sciences

Journal homepage:
<https://karyailham.com.my/index.php/jarsbs/index>
ISSN: 2462-1951



Gamified CLO Intelligence: Design and Prototype of an Intelligent Assessment Innovation for Future Learning in Higher Education

Nainatul Farzuha Nor^{1,*}, Valerie Bukas anak Marcus², Mohammad Naim Ismail³, Syahputra⁴

¹ Faculty of Business and Management, Open University Malaysia, 47301 Petaling Jaya, Selangor, Malaysia

² Faculty of Education, Open University Malaysia, 47301 Petaling Jaya, Selangor, Malaysia

³ School of Economics and Business, Telkom University, Bandung 40152 Jawa Barat, Indonesia

ARTICLE INFO

Article history:

Received 24 July 2026

Received in revised form 10 September 2026

Accepted 1 October 2026

Available online 6 October 2026

ABSTRACT

The rapid advancement of digital technologies and the emergence of Future Learning have transformed expectations for teaching, learning, and assessment in higher education. Within Outcome-Based Education (OBE), universities are expected to assess higher-order competencies through authentic and learner-centred approaches rather than relying solely on traditional examinations. However, conventional assessment methods often fail to capture students' strategic thinking, problem-solving, and decision-making skills in real-world contexts, limiting the quality of evidence for Course Learning Outcome (CLO) attainment. This study aims to develop Gamified CLO Intelligence (GCI), an intelligent assessment innovation that integrates gamification, Problem-Based Learning (PBL), and Outcome-Based Education to enhance CLO assessment in a Strategic Management course. The innovation transforms CLOs into interactive learning missions within a web-based business simulation, enabling students to formulate, implement, and evaluate strategic decisions across four progressive business lifecycle stages: foundation, growth, maturity, and transformation. A design and development research approach was employed to conceptualise the framework and develop a functional prototype. This paper presents the conceptual design and prototype development phase of the study. The prototype was designed by aligning game mechanics with CLO requirements, PBL principles, and authentic assessment practices to ensure instructional coherence and assessment validity. While empirical validation with students is slated for future work, the resulting prototype demonstrates the theoretical feasibility of embedding CLO assessment within an interactive learning environment. In conclusion, Gamified CLO Intelligence offers an innovative and future-ready assessment model that bridges pedagogy, technology, and authentic assessment practices. The innovation has the potential to improve learner engagement, strengthen evidence-based assessment of higher-order learning outcomes, and support digital transformation initiatives in higher education.

Keywords:

Outcome-based education; gamification; course learning outcomes; Problem-Based Learning; authentic assessment

1. Introduction

Future learning is increasingly characterised by flexible, technology-enabled, learner-centred and competency-oriented educational experiences. The transition toward Education 4.0 places greater emphasis on competencies, innovative learning methods, information and communication

technologies, and infrastructure that connects learning with changing professional and societal contexts [18]. The future learner is expected not only to acquire disciplinary knowledge but also to analyse complex information, solve unfamiliar problems, make decisions under uncertainty, collaborate, and adapt to changing environments. These expectations create a direct challenge for assessment because assessment systems must capture what learners can do with knowledge rather than only what they can recall.

Outcome-Based Education provides an important foundation for this shift because it starts with clearly specified learning outcomes and requires teaching and assessment activities to be aligned with those outcomes [4]. In Malaysian higher education, OBE has also been associated with systematic quality assurance, evidence-based monitoring of student performance, and continuous curriculum improvement [27]. However, the existence of CLO statements does not automatically guarantee meaningful CLO assessment. When higher-order CLOs are assessed mainly through conventional written examinations, learners may demonstrate theoretical understanding without sufficiently demonstrating the process of applying, evaluating, and defending decisions in authentic situations.

Authentic assessment has gained attention as a way of connecting assessment tasks with real-world performance. A recent systematic review found that authentic assessment can support critical thinking, problem-solving and collaboration, while also identifying implementation challenges such as staff preparation, resistance, resources and the need for coherent institutional strategies [29]. For Strategic Management, the issue is especially important because strategic competence is contextual. Students need to interpret market information, identify strategic issues, compare alternatives, select actions, implement choices and evaluate consequences. A static examination can test parts of this knowledge, but it is less capable of representing the iterative nature of strategic decision-making.

Problem-Based Learning offers one pedagogical response because it places learners in situations where they must diagnose problems, seek relevant information, evaluate alternatives and construct solutions. Recent evidence positions PBL as a useful approach for developing critical thinking, although its effectiveness depends on how learning problems, scaffolding and assessment processes are designed [32]. If PBL is implemented but evaluated using disconnected or predominantly subjective criteria, the connection between activity and CLO attainment can remain weak.

Gamification introduces another opportunity. It uses selected game elements in non-game contexts to shape motivation, participation, progression and feedback. Systematic evidence shows that educational gamification has been used across educational levels and learning fields, with many studies reporting positive effects; however, the diversity of implementations indicates that design quality and purpose matter [33]. Recent work on adaptive gamified assessment further suggests that game-based assessment can be connected with learner motivation and assessment processes rather than being limited to entertainment or reward systems [34]. At the same time, gamification can create undesirable effects when competition, points or leaderboards are poorly designed. Therefore, gamification should be governed by pedagogical purpose rather than added as decoration.

Against this background, this paper introduces Gamified CLO Intelligence (GCI), an assessment innovation developed for a Strategic Management course. The central proposition is that a CLO can be transformed into a sequence of interactive missions in which students demonstrate strategic competence through decisions and actions. The innovation combines four elements: OBE and CLO alignment, PBL scenarios, purposeful gamification, and learning evidence. The prototype is designed as a web-based business simulation comprising four progressive stages; foundation, growth, maturity and transformation.

The paper has four objectives: (1) to identify the assessment problem associated with measuring a complex Strategic Management CLO through conventional methods; (2) to develop a GCI

framework connecting CLO requirements with PBL, gamification and evidence generation; (3) to demonstrate the framework through a functional Strategic Management prototype; and (4) to discuss the educational significance, implementation implications and future validation requirements of the innovation.

2. Literature Review

2.1 Future Learning and Education 4.0

Education 4.0 is not simply the digitalisation of existing teaching materials. It represents a broader redesign of learning in response to technological change, changing work requirements and the need for transferable competencies. Miranda identifies competencies, learning methods, information and communication technologies, and infrastructure as interconnected components of Education 4.0 [18]. Rienties similarly show that Education 4.0 learning design is associated with innovation, technology use, employment connections and hands-on or project-oriented approaches [23].

The Future Learning perspective consequently requires assessment to evolve alongside pedagogy. If learning environments increasingly emphasise authentic tasks, collaboration, digital tools and complex problem solving, assessment must also provide opportunities to observe those competencies. The OECD frames future-ready learners in terms of creating value, acting as change agents and developing digital resilience [21]. These characteristics reinforce the need for assessment designs that capture processes of reasoning and action rather than only final written responses.

2.2 Outcome-Based Education and CLO Assessment

OBE places intended learning outcomes at the centre of curriculum design, teaching and assessment. At course level, CLOs translate broader programme expectations into observable and assessable achievements. Sun and Lee explain, in a Malaysian private higher education context, emphasise that OBE requires systematic processes for measuring student performance and using evidence for continuous improvement [27]. In the Malaysian context, the Malaysian Qualifications Agency (MQA) strictly mandates constructive alignment, requiring higher education institutions to provide robust, traceable evidence of CLO attainment. Consequently, assessments must generate credible, auditable evidence that can be interpreted by lecturers, programme teams, and quality assurance stakeholders.

The challenge becomes greater when a CLO combines multiple higher-order actions. The target CLO in the present innovation is: “Demonstrate various methods in formulating, implementing, and evaluating strategies in decision making.” The CLO requires students to move across formulation, implementation, evaluation and judgement. Consequently, a single end-point test may not adequately reveal how learners make decisions, respond to changing conditions or learn from consequences.

2.3 Problem-Based Learning and Higher-Order Thinking

PBL is particularly relevant to Strategic Management because strategic decisions are normally made in response to problems rather than isolated questions. Learners need to interpret an environment, identify the core problem, investigate relevant information, compare possible responses and justify action. Yu and Zin explain in a systematic review of critical-thinking-oriented adaptations of PBL, report that PBL is widely used to develop critical thinking but that adaptations and design features matter for achieving positive outcomes [32].

For assessment, PBL provides a rich source of evidence because students' reasoning and actions can be observed over time [1]. However, PBL does not automatically solve the assessment problem. Without explicit outcome mapping, assessment criteria may become overly dependent on participation, group processes or the quality of a final product. GCI therefore treats PBL as the scenario engine, while CLO mapping determines what evidence counts as achievement.

2.4 Gamification in Higher Education

Gamification can make learning activities more visible and progressive by introducing missions, levels, feedback, rewards and achievement structures. Zeybek and Saygı show that gamification is used for multiple educational purposes and contexts, but the literature contains considerable variation in design [33]. This supports a design principle for GCI: game mechanics should be selected because they support learning or assessment function.

Recent adaptive gamified assessment research demonstrates that gamification can be integrated into assessment rather than operating separately from it [34]. Nevertheless, innovation must avoid equating engagement with learning. Points, badges or leaderboards are not evidence of CLO attainment by themselves. Within GCI, progression is therefore conditional on completion of CLO-linked missions and strategic decision tasks. The game layer supports motivation and progression, while the assessment layer determines competency evidence.

2.5 Authentic Assessment and Learning Analytics

Authentic assessment is concerned with tasks that resemble meaningful applications of knowledge beyond the artificial structure of conventional tests. Vlachopoulos and Makri found that authentic assessment can support twenty-first-century skills such as critical thinking, problem-solving and collaboration, while noting implementation and resource challenges [29]. For Strategic Management, a simulation offers an appropriate authentic context because business decisions have consequences, constraints and trade-offs.

Learning analytics provides an additional bridge between digital activity and assessment evidence. Sembey shows that emerging technologies, including learning analytics, artificial intelligence and extended reality, are increasingly considered in higher education assessment and feedback [26]. However, technology should not be treated as a substitute for sound assessment design. GCI therefore positions analytics as an evidence-support mechanism: it records progression and performance information that lecturers can interpret alongside the quality of students' strategic decisions and reflections.

2.6 Research Gap

The literature suggests three partially separated streams. First, OBE provides the logic for defining and measuring outcomes. Second, PBL provides authentic problems through which higher-order thinking can be developed. Third, gamification provides mechanisms for engagement, progression and feedback. The gap is not the absence of these individual approaches; rather, it is the limited integration of all three around a specific CLO and an assessment evidence architecture. GCI addresses this gap by treating the CLO as the central design object. Instead of starting with a game and then attaching learning outcomes, the design starts with the CLO, decomposes it into assessable dimensions, embeds each dimension in a PBL scenario, and then uses gamification to organise progression and feedback [6].

3. Methodology

This study adopts a Design-Based Research (DBR) approach. DBR is appropriate when the research objective is to develop and refine an educational artefact while maintaining a strong connection between theory, instructional problems and practical implementation [28]. Scott describe DBR as a methodology capable of connecting learning theory with the design of instructional tools, while Tinoca show that DBR is increasingly used in educational research because its iterative structure supports practical applicability [25,28].

The present study represents an early-stage DBR cycle focused on problem analysis, conceptual design, prototype development and instructional alignment. It is important to distinguish this from a full experimental evaluation. The study does not claim causal effects on student achievement because no controlled intervention, participant sample or inferential statistical analysis was conducted at this stage. The prototype is therefore treated as a proof-of-concept artefact whose feasibility and pedagogical coherence can be examined before empirical implementation.

3.1 DBR Development Process

1. Problem analysis: identify the mismatch between a complex Strategic Management CLO and conventional assessment formats.
2. Design specification: translate the CLO into observable strategic behaviours and define the evidence required for each behaviour.
3. Pedagogical integration: embed the evidence requirements within PBL scenarios and select game mechanics that support progression, feedback and motivation.
4. Prototype development: implement the design as a web-based four-level business simulation.
5. Alignment review: conduct an internal, theoretical examination by the research team to verify whether each level, task, game mechanic, and evidence output remains connected to the target CLO.
6. Future validation: prepare the prototype for expert review and subsequent empirical testing with students.

This process reflects the iterative character of DBR. The current paper reports on the developed artefact and its design rationale rather than presenting a completed cycle of student testing.

3.2 Design Requirements

Table 1

Design requirements

Requirement	Design response	Evidence generated
CLO alignment	Each level is mapped to formulation, implementation, evaluation or integrated decision-making.	Mission completion and decision performance.
Authentic problem solving	Business scenarios contain constraints, trade-offs and incomplete information.	Strategic choices and rationale.
Progressive learning	Four business lifecycle stages increase complexity.	Level progression and mastery evidence.
Purposeful gamification	Levels, unlocking, feedback and achievement mechanisms support learning progression.	Gameplay records and feedback events.

Table 1 (Continued)

Requirement	Design response	Evidence generated
Reflective learning	Reflection prompts follow strategic decisions.	Student explanations and lessons learned.
Traceability	Digital activity is mapped to CLO indicators.	Structured lecturer evidence.

4. Gamified CLO Intelligence Framework

The proposed GCI framework places CLO requirements at the centre of the learning architecture. It contains six connected components: OBE and CLO requirements, CLO mission mapping, PBL strategic scenarios, gamified progression, student decision evidence, and learning analytics. The framework is intended to prevent game mechanics from becoming the dominant design feature. Pedagogical and assessment requirements remain the controlling logic.

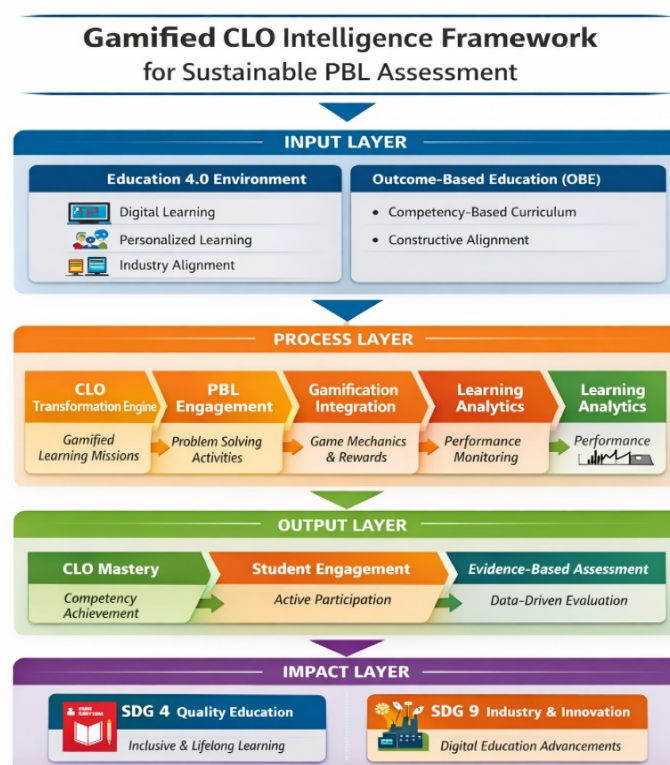


Fig. 1. Gamified CLO intelligence framework

4.1 CLO Mission Mapping Layer

The first layer converts the target CLO into observable dimensions. For the Strategic Management course, the dimensions are strategy formulation, strategy implementation, strategic evaluation and integrated strategic decision-making. Each dimension becomes a mission that requires a student action. This approach changes the CLO from a static statement into an operational design specification.

4.2 PBL Engagement Layer

The second layer provides authentic strategic problems. Students receive a business situation rather than a predetermined question with one correct answer. They must diagnose the problem, interpret information, compare options and select a response. The scenario structure encourages students to apply strategic frameworks in context.

4.3 Gamification Mechanics Layer

The third layer organises the learning experience through progression, unlocking, immediate feedback and achievement recognition. These mechanics are deliberately connected to task completion and mastery. A student does not progress simply because time has elapsed; progression is associated with completion of the learning mission.

4.4 Learning Evidence Layer

The fourth layer captures evidence generated by gameplay. Evidence includes decisions made, tasks completed, level progression and reflections. Where the platform is technically capable, these events can be aggregated into a lecturer dashboard. The dashboard should support—not replace—professional judgement, because automated activity data cannot fully represent the quality of strategic reasoning.

5. Prototype: Strategic Management Simulation

A functional prototype was developed as a web-based Strategic Management simulation. The prototype operationalises the GCI framework through four progressive levels representing a simplified business lifecycle. Table 2 and figure 2 illustrates that the prototype as each level is designed as an online business simulation to be completed over a one-week period, with an estimated 10 hours of independent learning for assessment (NF2F). Students are expected to engage with the simulation, analyse business scenarios, make strategic decisions, evaluate outcomes, and complete the required assessment tasks independently.

Table 2

Prototype: Strategic management simulation

Level	Lifecycle stage	Strategic focus	CLO dimension	PBL activity
1	Foundation	Business model and value proposition	Strategy formulation	Identify the strategic problem and select a viable strategic direction.
2	Growth	Market expansion and competitive strategy	Strategy implementation	Apply strategic choices to a growth situation under resource constraints.
3	Maturity	Portfolio management using BCG logic	Strategic evaluation	Evaluate business units and determine resource priorities.
4	Transformation	Innovation and strategic renewal	Integrated decision-making	Synthesize multiple factors and select a transformation strategy.

Level 1 establishes the business context and requires students to move from environmental information to a strategic choice. Level 2 increases complexity by introducing growth decisions and implementation constraints. Level 3 focuses on evaluation and portfolio choices, requiring students to compare alternatives rather than merely identify a strategy. Level 4 represents transformation and

requires integrated decision-making under greater uncertainty. The sequence is intended to create a cognitive progression from focused application toward synthesis and judgement.

The prototype also uses visible progression so that students can understand where they are in the learning journey. Immediate feedback is used to explain consequences or provide guidance after selected tasks. Reflection prompts are positioned after major decisions to encourage learners to explain why a particular strategy was chosen and what could be changed in a subsequent round.

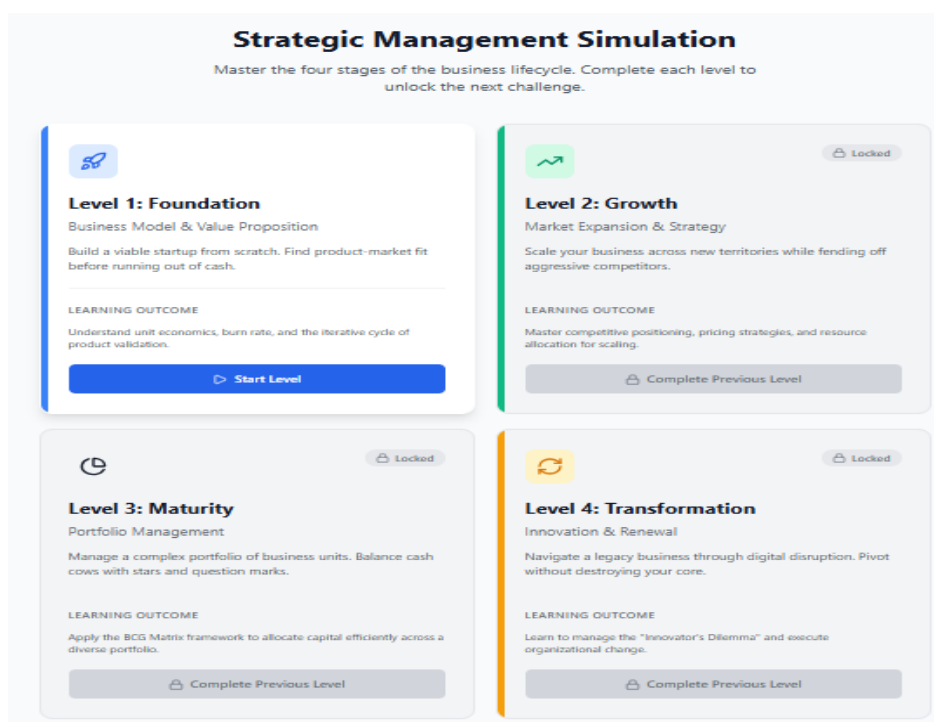
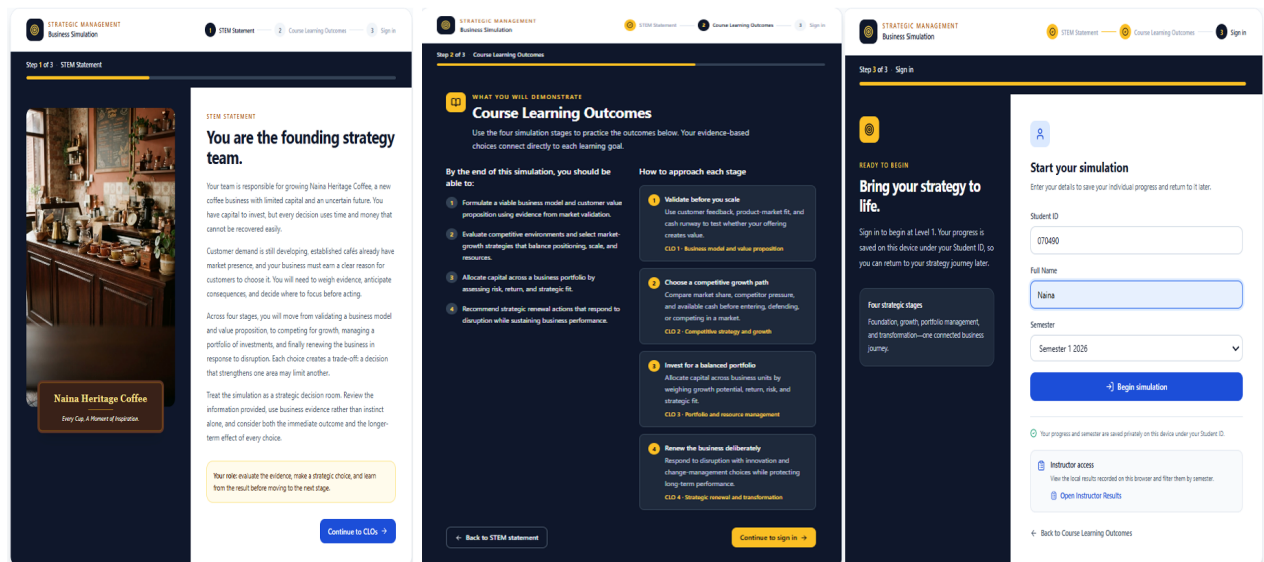


Fig. 2. Prototype: Strategic management simulation

6. CLO–PBL–Gamification Alignment

The principal design contribution of GCI is the explicit alignment among the CLO, PBL problem, student action, game mechanic and assessment evidence. Table 3 illustrates the alignment logic.

Table 3

CLO–PBL–gamification alignment

Level	Problem	Student action	Game mechanic	Evidence	Assessment interpretation
1-Foundation	Unclear value proposition and competitive direction	Diagnose and formulate	Mission + unlock	Strategic choice + rationale	Formulation
2-Growth	Limited resources and market pressure	Select and implement	Progression + feedback	Implementation decision	Implementation
3-Maturity	Competing business units	Evaluate portfolio options	Challenge score	+ Portfolio recommendation	Evaluation
4-Transformation	Disruption and need for renewal	Integrate multiple strategic factors	Final mission + achievement	Integrated decision + reflection	Strategic judgement

This alignment is significant because the presence of a game mechanic is not treated as evidence of learning. For example, a badge may indicate mission completion, but the assessment interpretation comes from the strategic decision embedded within that mission. Likewise, progression indicates that a learner has completed a sequence of tasks; it does not independently prove mastery. This distinction strengthens assessment validity by separating engagement indicators from competency evidence.

7. Principal Results

7.1 CLO Becomes an Interactive Assessment Architecture

The first design outcome is the conversion of a broad CLO into observable strategic actions. Instead of assessing formulation, implementation and evaluation only through a final written response, the prototype distributes these dimensions across four stages. This creates multiple points at which evidence can be generated and interpreted.

7.2 Learning and Assessment Are Integrated

The second design outcome is the integration of learning activity and assessment. Students learn through the same decision tasks that generate evidence for the CLO. This reduces the separation between teaching activity and assessment activity. The approach is consistent with constructive alignment because learning tasks, intended outcomes and assessment evidence are designed as connected components.

7.3 The Prototype Creates a Foundation for Learning Analytics

The third design outcome is the establishment of a digital evidence structure. Because the simulation records progression and task completion, the platform can potentially aggregate information into learning analytics for lecturer monitoring. This is a design capability rather than an

empirically demonstrated effect. Future implementation should determine which indicators are valid, how they should be weighted, and how lecturer judgement should be incorporated.

8. Discussion

GCI contributes to future learning by treating assessment as an interactive learning experience rather than an event that occurs only after teaching. The design responds to Education 4.0 principles by combining technology, active learning, competency development and authentic problem solving. Miranda and Rienties emphasise the relationship between technology, innovative pedagogies and competencies in Education 4.0. GCI translates these broad principles into a concrete course-level assessment architecture [18,23].

The innovation is also consistent with the future-ready learner profile described by the OECD [21]. Strategic simulations require learners to interpret information, make choices, respond to consequences and reflect on alternative actions. These are not merely technical skills; they involve judgement and adaptability. Thus, the value of GCI lies not in making a course look more digital but in creating opportunities to practise the kinds of decision-making that future professional environments demand.

The second contribution is to OBE implementation. OBE can become documentation-heavy when CLOs are written clearly but evidence of attainment remains disconnected from everyday learning activities. GCI provides a mechanism through which the CLO becomes the organising unit of a digital learning experience. This can improve traceability because the lecturer can identify which mission corresponds to which CLO dimension and what evidence is produced.

At institutional level, the model may also support quality assurance by making evidence easier to organise. However, the innovation should not be presented as a replacement for established assessment moderation or quality assurance processes. Rather, it can provide an additional evidence stream that complements assignments, examinations, presentations and other assessment forms.

Furthermore, while the integration of learning analytics offers significant advantages for tracking student decision-making, it also introduces ethical considerations. Future implementations of GCI must ensure that data privacy is maintained, and students are transparently informed about how their gameplay data is collected, interpreted, and used for high-stakes grading. The technology should serve as a transparent tool for empowerment rather than a hidden surveillance mechanism.

The third contribution is conceptual. Much educational gamification begins with a conventional learning activity and adds points, badges or competition. GCI instead begins with the learning outcome and uses gamification to structure the path through which the outcome is demonstrated. This distinction shifts gamification from an engagement layer toward an assessment architecture.

The design also responds to concerns about the unintended effects of gamification. Competitive mechanics should be used carefully because they can create undesirable motivational or behavioural consequences. GCI therefore emphasises mission completion, progression, feedback and evidence rather than ranking students as the primary mechanism. Where leaderboards are used, they should be optional or designed around team or mastery goals rather than public individual comparison.

Emerging technologies are increasingly influencing assessment and feedback practices in higher education [26]. GCI illustrates one pathway for using digital technology without allowing technology to determine pedagogy. The digital platform is valuable because it enables repeated simulation, immediate feedback, progression tracking and structured evidence capture. These functions would be difficult to reproduce efficiently through purely paper-based assessment.

Nevertheless, the framework adopts a human-centred position. Lecturer judgement remains important in interpreting strategic decisions, especially when multiple responses may be defensible.

Future development should therefore focus on explainable analytics, transparent scoring criteria, privacy-aware data practices and opportunities for students to understand how their evidence is interpreted.

9. Implications for Practice

9.1 Implications for Lecturers

- Begin assessment design with the CLO and define the observable evidence required before selecting game mechanics.
- Use short, authentic problems that require students to make decisions rather than merely identify correct answers.
- Use progression to represent increasing complexity and mastery rather than simple completion.
- Combine automated activity records with lecturer judgement and reflective responses.
- Use prototype analytics to identify where learners struggle, then redesign teaching support or subsequent missions.

9.2 Implications for Programme and Quality Teams

- Map digital missions to course and programme outcomes to strengthen assessment traceability.
- Use aggregated evidence as one source for continuous quality improvement rather than as the sole indicator of course quality.
- Develop common design standards for gamified assessment to ensure consistency across courses.
- Provide staff development in authentic assessment, PBL facilitation, gamification design and learning analytics.

9.3 Implications for Future Learning Design

The model can potentially be adapted beyond Strategic Management. Any course containing complex, observable processes such as entrepreneurship, project management, operations, leadership, professional practice or business analytics could use a similar architecture. The content of the scenarios would change, but the underlying logic of CLO mapping, authentic problem solving, purposeful gamification and evidence generation could remain.

10. Limitations and Future Research

Several limitations must be acknowledged. First, the present study is a design and prototype paper rather than an empirical effectiveness study. No student sample was used to estimate changes in achievement, engagement or strategic thinking. Second, the prototype was developed around one Strategic Management CLO; transferability to other disciplines requires further design and validation. Third, the current evidence is primarily design-based. The reliability and validity of individual gameplay indicators must be empirically tested before they are used for high-stakes assessment.

Future research should proceed through iterative validation. An initial expert review can examine content validity, CLO alignment, usability and pedagogical coherence. A subsequent pilot study can examine learner experience and technical usability. Later quasi-experimental or mixed-method

studies can compare GCI-supported assessment with conventional assessment on measures such as CLO attainment, strategic decision-making, engagement and retention. Learning analytics can also be investigated to determine which gameplay events are genuinely predictive of learning rather than merely predictive of activity.

Future versions may incorporate adaptive pathways, where the difficulty or type of strategic problem changes according to learner performance. Artificial intelligence may eventually support feedback or scenario generation, but such features should be introduced only after the underlying assessment logic is validated. The priority should remain trustworthy evidence of learning rather than technological novelty.

11. Conclusion

This paper introduced Gamified CLO Intelligence as an intelligent assessment innovation for Future Learning in higher education. The central innovation is the transformation of a complex Strategic Management CLO into a sequence of interactive, problem-based missions within a web-based business simulation. By connecting OBE, PBL, gamification and learning evidence, the design moves beyond the conventional use of gamification as an engagement technique.

The functional prototype demonstrates the feasibility of a four-level assessment journey covering foundation, growth, maturity and transformation. Each stage is linked to a strategic decision-making dimension and produces observable evidence through student actions, progression and reflection. The framework also establishes a foundation for future learning analytics and lecturer monitoring.

The study does not claim that the prototype has already improved student achievement because empirical testing has not yet been conducted. Instead, its contribution is the design of a coherent assessment architecture that can be empirically tested. This distinction strengthens the research integrity of innovation and provides a clear pathway for future validation.

Overall, GCI demonstrates how Future Learning can be operationalised at course level by redesigning assessment around authentic action, higher-order thinking and digital evidence. Innovation offers a promising pathway for higher education institutions seeking to make CLO assessment more interactive, traceable and future-ready.

Acknowledgement

This research was not funded by any a grant.

References

- [1] Almarashdeh, I., & Younes, A. (2021). The impact of gamification on students' motivation and engagement in higher education: A case study of a gamified course. *International Journal of Instruction*, 14(2), 183-200. <https://doi.org/10.29333/iji.2021.14211a>
- [2] Aminah, Siti, Adila Alfa Krisnadhi, and Achmad Nizar Hidayanto. "Ontological framework for the analysis of outcome-based curriculum in higher education." *IEEE Access* 13 (2025): 31497-31516. <https://doi.org/10.1109/ACCESS.2025.3542881>
- [3] Anderson, James A., and Ronald A. Crutcher. *Driving change through diversity and globalization: Transformative leadership in the academy*. Routledge, 2023.
- [4] Asbari, Masduki, and Dewiana Novitasari. "Outcome-based education model: Its impact and implications for lecturer creativity and innovation in higher education." *International Journal of Social and Management Studies* 5, no. 5 (2024): 22-31. <https://doi.org/10.5555/ijosmas.v5i5.447>
- [5] Asim, Hafiz Muhammad, Anthony Vaz, Ashfaq Ahmed, and Samreen Sadiq. "A Review on Outcome Based Education and Factors That Impact Student Learning Outcomes in Tertiary Education System." *International Education Studies* 14, no. 2 (2021): 1-11. <https://doi.org/10.5539/ies.v14n2p1>

- [6] Asy-Syila, Amalia. "Strategies for enhancing student motivation and achievement." *Mauve Journal De Leardu* 1, no. 1 (2024): 14-25. <https://doi.org/10.37899/mjdl.v1i1.6>
- [7] Barata, G., Gama, S., & Jorge, J. (2017). Gamification in education: A systematic review. In Proceedings of the International Conference on e-Learning (pp. 43-50). Academic Conferences International Limited. <https://doi.org/10.1016/j.chb.2016.08.049>
- [8] Damit, Mohd Amiruddin Ag, Muhd Khaizer Omar, and Mohd Hazwan Mohd Puad. "Issues and challenges of outcome-based education (OBE) implementation among Malaysian vocational college teachers." *International Journal of Academic Research in Business and Social Sciences* 11, no. 3 (2021): 197-211. <https://doi.org/10.6007/IJARBS/v11-i3/8624>
- [9] Vitty, F. A. C., S. Sabariah, and M. S. Nuryati. "Gamification for enhancing students' learning motivation: a systematic review." *Journal of Cognitive Sciences and Human Development* 10, no. 2 (2024): 19-41. <https://doi.org/10.33736/jcshd.7231.2024>
- [10] Guo, Qian, Halimah Jamil, Lilliati Ismail, Shujie Luo, and Zhubin Sun. "Effects of problem-based learning on EFL learning: A systematic review." *PloS One* 19, no. 12 (2024): e0307819. <https://doi.org/10.1371/journal.pone.0307819>
- [11] Hassan, Z., & Omar, S. (2023). Digital pedagogy in Malaysian higher education: Challenges and opportunities. *Journal of Education Innovation*, 8(2), 112–126.
- [12] Keo, Vireak, Bunrosy Lan, Rany Sam, and Wen Rouet. "Exploring EFL students' challenges in oral presentations at National University of Battambang." *International Journal of Professional Development, Learners and Learning* 7, no. 2 (2025): e2513. <https://doi.org/10.30935/ijpdll/16111>
- [13] Khan, Md Shahadat Hossain, Nafiu Salele, Mahbub Hasan, and Benadjih Oiriddine Abdou. "Factors affecting student readiness towards OBE implementation in engineering education: Evidence from a developing country." *Heliyon* 9, no. 10 (2023). <https://doi.org/10.1016/j.heliyon.2023.e20905>
- [14] Khursenko, S. M. (2023). Application of problem-based learning method in the training of engineering specialists. Bulletin of Sumy National Agrarian University. Series "Mechanization and Automation of Production Processes", 2(52), 81-85. <https://doi.org/10.32782/msnau.2023.2.12>
- [15] Killen, Roy. "Outcomes-based education: Principles and possibilities." *Unpublished manuscript, University of Newcastle, faculty of education* (2000): 1-24.
- [16] Lan, Bunrosy, Rany Sam, Vireak Keo, and Wen Roeut. "Academic adjustment of freshmen in Cambodian higher education institutions: A systematic literature review." *Journal of General Education and Humanities* 3, no. 2 (2024): 169-196.
- [17] Lan, B., R. Sam, V. Keo, and W. Rouet. "Factors influencing academic adjustment and learning outcomes in higher education institutions in Battambang: A conceptual framework." *European Journal of Theoretical and Applied Sciences* 2, no. 5 (2024): 9-30. <https://doi.org/10.58421/gehu.v3i2.203>
- [18] Miranda, Jhonattan, Christelle Navarrete, Julieta Noguez, José-Martin Molina-Espinosa, María-Soledad Ramírez-Montoya, Sergio A. Navarro-Tuch, Martín-Rogelio Bustamante-Bello, José-Bernardo Rosas-Fernández, and Arturo Molina. "The core components of education 4.0 in higher education: Three case studies in engineering education." *Computers & Electrical Engineering* 93 (2021): 107278. <https://doi.org/10.1016/j.compeleceng.2021.107278>
- [19] Molano, Teresita. "Bridging the gap between knowledge and practice on the implementation of outcomes-based education." *JETT* 14, no. 5 (2023): 122-134. <https://doi.org/10.47750/jett.2023.14.05.016>
- [20] Noushad, P. P. "Designing a Course Using the Obe Framework." In *Designing and Implementing the Outcome-Based Education Framework: Theory and Practice*, pp. 267-303. Singapore: Springer Nature Singapore, 2024.
- [21] OECD. (2024). Reimagining education, realising potential: The future of learning and implications for teaching. OECD Publishing. <https://doi.org/10.1787/b44e2c39-en>
- [22] Pham, Huong Thi, and Phuong Vu Nguyen. "ASEAN quality assurance scheme and Vietnamese higher education: a shift to outcomes-based education?." *Quality in Higher Education* 30, no. 2 (2024): 285-312. <https://doi.org/10.1080/13538322.2023.2261974>
- [23] Rienties, Bart, Rebecca Ferguson, Dalibor Gonda, Goran Hajdin, Christothea Herodotou, Francisco Iniesto, Ariadna Llorens Garcia et al. "Education 4.0 in higher education and computer science: A systematic review." *Computer Applications in Engineering Education* 31, no. 5 (2023): 1339-1357. <https://doi.org/10.1002/cae.22643>
- [24] Bassanelli, Simone, Antonio Bucchiarone, and Federica Gini. "Gamidoc: The importance of designing gamification in a proper way." *IEEE Transactions on Games* 17, no. 1 (2024): 13-31. <https://doi.org/10.1109/TG.2024.3364061>

- [25] Scott, Emily E., Mary Pat Wenderoth, and Jennifer H. Doherty. "Design-based research: A methodology to extend and enrich biology education research." *CBE—Life Sciences Education* 19, no. 2 (2020): es11. <https://doi.org/10.1187/cbe.19-11-0245>
- [26] Sembey, Ruchi, Rashina Hoda, and John Grundy. "Emerging technologies in higher education assessment and feedback practices: A systematic literature review." *Journal of Systems and Software* 211 (2024): 111988. <https://doi.org/10.1016/j.jss.2024.111988>
- [27] Sun, Poi Hun, and Sek Yan Lee. "The importance and challenges of outcome-based education –a case study in a private higher education institution." *Malaysian Journal of Learning and Instruction* 17, no. 2 (2020): 253-278. <https://doi.org/10.32890/mjli2020.17.2.9>
- [28] Tinoca, Luís, João Piedade, Sofia Santos, Ana Pedro, and Sara Gomes. "Design-based research in the educational field: A systematic literature review." *Education Sciences* 12, no. 6 (2022): 410. <https://doi.org/10.3390/educsci12060410>
- [29] Vlachopoulos, Dimitrios, and Agoritsa Makri. "A systematic literature review on authentic assessment in higher education: Best practices for the development of 21st century skills, and policy considerations." *Studies in Educational Evaluation* 83 (2024): 101425. <https://doi.org/10.1016/j.stueduc.2024.101425>
- [30] Wanti, Mega, Renate Wesselink, Harm Biemans, and Perry den Brok. "Determining factors of access and equity in higher education: A systematic review." *Equity in Education & Society* 1, no. 2 (2022): 279-296. <https://doi.org/10.1177/27526461221092429>
- [31] Elhussein, G., T. Leopold, A. Silva, and S. Zahidi. "Defining education 4.0: A taxonomy for the future of learning." In *World Economic Forum*. 2023.
- [32] Yu, Ling, and Zuhana Mohamed Zin. "The critical thinking-oriented adaptations of problem-based learning models: a systematic review." In *Frontiers in Education*, vol. 8, p. 1139987. Frontiers Media SA, 2023. <https://doi.org/10.3389/feduc.2023.1139987>
- [33] Zeybek, Nilüfer, and Elif Saygi. "Gamification in education: Why, where, when, and how?—A systematic review." *Games and Culture* 19, no. 2 (2024): 237-264. <https://doi.org/10.1177/15554120231158625>
- [34] Zhang, Zhihui, and Xiaomeng Huang. "Exploring the impact of the adaptive gamified assessment on learners in blended learning." *Education and Information Technologies* 29, no. 16 (2024): 21869-21889. <https://doi.org/10.1007/s10639-024-12708-w>