

DSAI White Paper - August 2025

This whitepaper is created to summarize how Gamified Assessment tool provides learning diagnosis in public schools through Deepspatial GeoAI powered platform.

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DSAI Whitepaper – Gamified Assessments as a Scalable Tool for Learning Diagnosis in Public Schools

Executive Summary

This paper demonstrates the transformative application of Deepspatial's GeoAI powered platform which integrates Gamified Assessment technique with AI analytics to provide robust learning diagnostics in public school education systems worldwide, including low- and middle-income and resource-constrained settings. Thus, by integrating the gamified assessment design with AI-powered diagnostics, the platform aims to bridge the gap between learner engagement, competency-based evaluation, and actionable insights. Further, the game design is aligned with the pedagogical directives of the international standards, and competency-based education frameworks enabling the operationalization of foundational literacy and numeracy (FLN) and other core learning competencies across diverse curricular contexts. Through adaptable content architecture, the system supports alignment with the regional education frameworks, and global learning benchmarks, ensuring contextual relevance while maintaining comparability across geographies. The system incorporates psychometric modeling and behavior analytics, using Item Response Theory (IRT) and Graded Response Models (GRM) approach to analyze the student responses across multiple learning dimensions. These analytics allow for learning outcome (LO) tagging, skill trajectory modeling, and heatmap visualization, even in areas with limited digital infrastructure. The game-based learning enhances both the short-term engagement and long-term retention, and comparative analysis further indicates the difference between traditional paper-based assessment and gamified assessments in pilot implementations indicate which significantly improved learner motivation, deeper diagnostics, and reduced test-related anxiety. This paper presents not merely as a technology product, but as a decision-intelligence framework that equips stakeholders' teachers, administrators, and policymakers with evidence-based insights to drive instructional interventions, resources allocation, and policy formulation By prioritizing personalized learning pathways, diagnostic accuracy, scalability, and equity of access, the proposed system lays a strong foundation for inclusive and sustainable educational transformation at a global scale.

1. Introduction: Rethinking Assessment in Public Schools

Public education system is undergoing a transformational change with an increased emphasizes on the competency-based learning, foundational literacy and numeracy (FLN), and tailored instruction, worldwide. However, there are certain progressive reforms but the assessment approach in many educational systems remains a paper-based, summative assessment and often disconnected from real-time pedagogical feedback and classroom-level decision-making[1,2].

Traditional assessment method often oriented around high-stakes examinations prioritize the ranking over learning, with the limited scope for the diagnosing skill gaps or adapting instruction based upon student needs[3]. Thus, the traditional approach does not offer granular insights into the Learning Outcomes (LOs) or 21st-century skills, which are now center to the global education agendas[4,5]. Furthermore, the paper-based formats fail to engage the learners expressively, especially in resource-constrained or multilingual classrooms, which cognitive and motivational challenges compound existing disparities. Hence, to bridge the gaps and challenges in traditional assessment, the need of hour is a diagnostic assessment tool that is:

- Engaging and student-centered, capable of stimulating intrinsic motivation through meaningful interactions.
- System operable in low-technology solution or hybrid digital environments, concerning the infrastructural realties of rural and remote locations.
- Curriculum-aligned and globally adaptable, supporting national and sub-national curricula while aligning with international FLN benchmarks and competency-based education frameworks.
- Provides actionable insights at the classroom, and system level for the stakeholders including teachers, administrators, and policymakers alike.

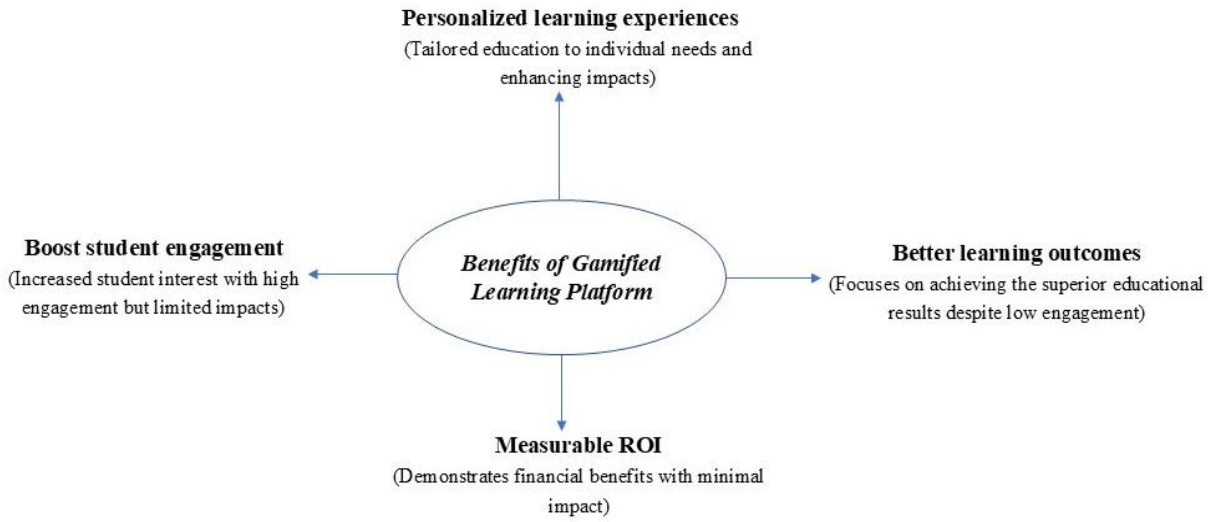

Figure 1. Benefits of Gamified Learning Platform.

The assessment approach builds on the evidence from global research which shows that how gamified assessment improves the engagement, cognitive management, and learning outcomes as shown in figure 1[6,7,8]. Moreover, recent studies have shown how AI-powered formative assessments when aligned with national curricula can be scaled in public schools without adding burdens to teachers[9,10]. By utilizing GeoAI framework within the broader ecosystem of public sector educational innovation, this paper aims to demonstrate that gamified diagnostics are not only feasible at scale but essential for advancing personalized, competency-driven learning and for achieving the objectives of Sustainable Development Goal 4 (SDG 4) and related global education commitments.

2. Gamified Assessment Framework

2.1 Game Design Pedagogy

The Deepspatial AI gamified assessment framework are rooted in constructivist and experiential learning theories which emphasizes active, and hands-on knowledge building through interactive tasks, problem-solving, and critical thinking.

- **Constructivist Foundations:**
  Students construct understanding by grappling with meaningful tasks. AI framework-based game mechanics facilitate learning by doing in contexts underpinned by problem-centeredness, discovery, and social interaction.
- **Game Elements that Drive Engagement:**
  The digital platform incorporates narrative arcs, progression systems (points, badges), immediate feedback, scaffolded challenges, and mastery pathways techniques which are known to enhance the motivation and sustained interest.

- **Alignment with Global Curriculum and Competency Frameworks:**
  The game-based tasks aligned with the international competency-based education models, foundational learning benchmarks, and curriculum standards advocated by global organizations such as OECD, UNESCO, and the World Bank. The framework supports adaptable, curriculum-agnostic implementation, enabling alignment with foundational literacy, numeracy, and transversal skills across varied education systems.

Hence, the key design converges with the larger educational visions where the constructivism, experiential learning, and motivational principles such as flow and self-determination are seen as key theories which are effective for game-based learning.

2.2 Behavioural and Cognitive Analytics

Advanced Deepspatial GeoAI platform leverages the fine-grained data capturing each student interaction, movement, and response potential to produce rich insights into learning behavior. The game-based platform captures:

- Response patterns and hesitation time.
- Error trends, concept confusion, and misconceptions.
- Engagement levels and motivation indicators.
- Telemetry feed into the AI-driven analytics map concept mastery predicts learning readiness, and further guides the personalized interventions.

Therefore, the game analytics framework suggest that the telemetry is foundational for transforming behavior into valid learning inferences, with special focus to the cognitive demands and precision in data granularity. Moreover, the game-based learning analytics outlines the approach to understand with and learn from serious games.

Table 1: Summary Table.

Aspect	**Deepspatial AI Implementation**	**Literature Foundation**
Constructivist pedagogy	Interactive problem-based game design aligned with Global Curriculum	Constructivist gamification models, narrative and engagement theory[11,12]
Analytics via telemetry	Captures fine-grained behaviors to model mastery and engagement	Game telemetry design principles; GLA frameworks; educational data mining insights[13,14]

3. Comparative Efficiency: Paper-Based vs Gamified Assessments

In pilot studies in government public schools, gamified assessment showed:

- Higher student engagement and reduced anxiety.
- More granular diagnostic insights.
- Faster feedback loops to teachers and school heads.

A comparative analysis further revealed that students assessed using Deepspatial AI-enabled gamified approach exhibited stronger conceptual understanding across subjects and grade levels than their peers evaluated through traditional paper-based assessments.

Table 2. Bottom Comparison Bar (Efficiency Indicators)

Dimension	Paper-Based	Gamified (AI-Enabled)
Student Engagement	Low–Moderate	High
Anxiety Levels	High	Reduced
Diagnostic Depth	Limited	High-Granularity
Feedback Speed	Delayed	Real-Time
Conceptual Understanding	Surface-Level	Deep and applied

4. Diagnostic Visualization and Learning Outcome Mapping

Gamified assessment framework is an essential module as its diagnostic visualization engine which translates raw gameplay datasets into the actionable learning intelligence. The visualization method ensures that the assessment results are not stored in the reports but are meaningfully interpreted for the pedagogical and policy action. DSAI technology provides useful insights like:

4.1 Student-Level Insights

Gamified assessment productions are mapped directly to the specific Learning Outcomes (LOs) as defined by frameworks aligned with internationally recognized curriculum and competency frameworks used by education systems worldwide (Fig. 2).

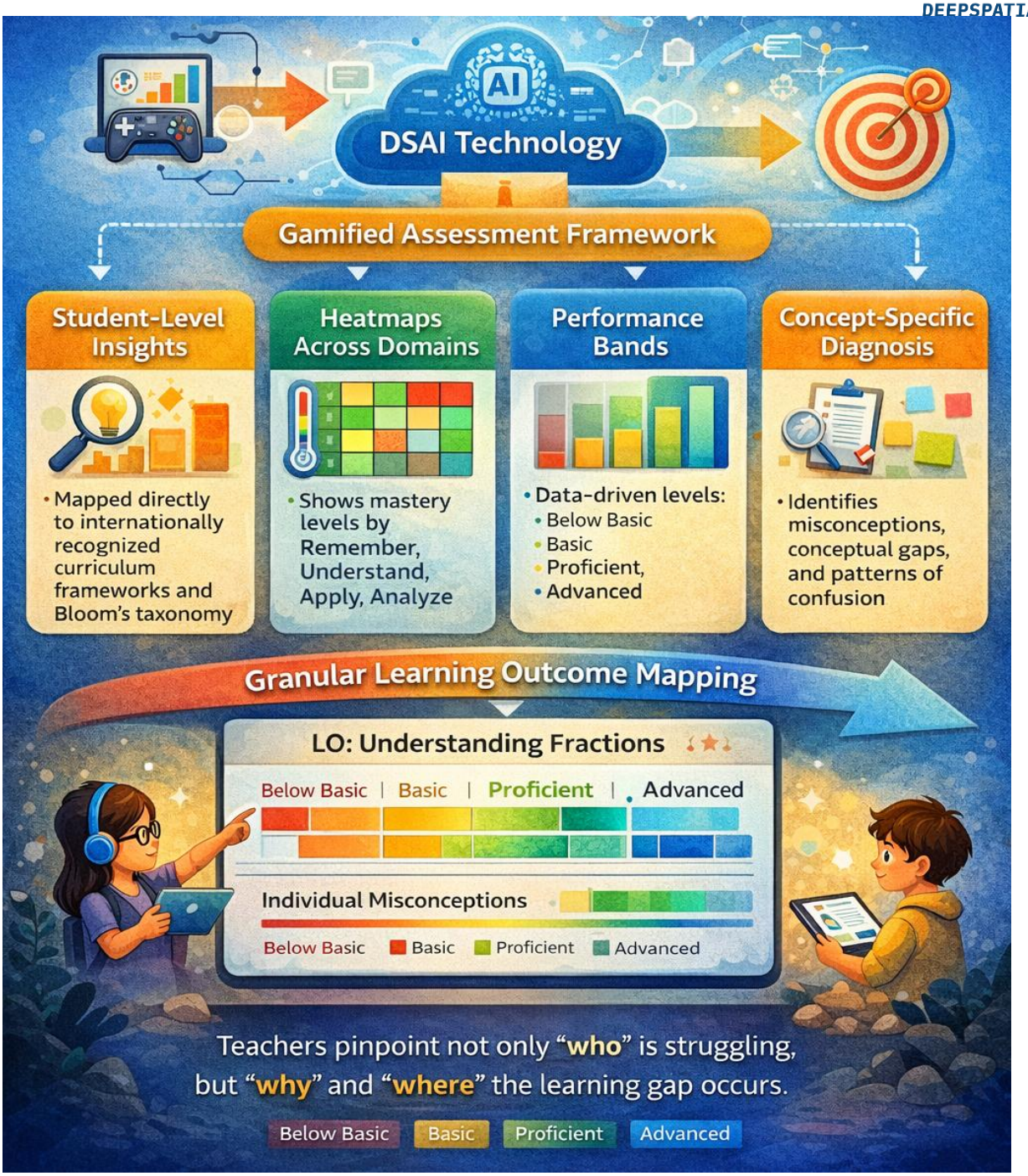

Figure 2. DSAI Technology-Gamified Assessment Framework.

- **Heatmaps Across Domains:**
  Color-coded visual representations show mastery levels across Bloom's taxonomy categories (e.g. Remember, Understand, Apply, Analyze).
- **Performance Bands**:
  Students are placed in the data-driven performance levels: Below Basic, Basic, Proficient, Advanced, like banding approaches adopted in large-scale international assessments such as NAEP, PISA, and other standards-based evaluation systems.

- **Concept-Specific Diagnosis**: Identification of misconceptions, conceptual gaps, and patterns of confusion.

This granular LO-mapping allows teachers to pinpoint not only "who" is struggling but also "why" and "where" the learning gap occurs[15].

4.2 School-Level Dashboards

At the school level, DSAI platform aggregates data into leadership dashboards for principals, cluster heads, and district education officers.

- Intervention Zone Identification – School heatmaps highlight grades, subjects, or competencies where intervention is most needed.
- Progress Tracking Over Time – Enables monitoring of the impact of remedial programs, resource deployment, and teacher training on student outcomes[16].
- Equity and Inclusion Metrics – Disaggregation by socio-economic, gender, and geographic location to ensure equitable learning progress.

4.3 Support for Teacher Professional Development

The platform can support and empowers the school leaders to suggests the instruction by linking the diagnostic results as per the teacher training modules. For example, if multiple students display weaknesses in the "fractions" within mathematics, the system can suggest the micro-learning modules for teachers to address that skill gap[17]. The use of visualized, evidence-based feedback strengthens teacher self-efficacy, supports reflective practice, and enables data-informed lesson planning. This approach aligns with global competency-based education (CBE) principles, which emphasize mastery, continuous feedback, and personalized professional growth.

5. Challenges in Government Implementation

Despite the promise, implementation across public school system present challenges:

- Digital infrastructure gaps in rural, tribal regions and some challenging hilly terrain regions.
- Teacher training needs for technology adoption and data interpretation.
- Alignment with state-specific learning outcome frameworks.
- Data privacy and policy compliance in line with national/regional platforms and standards.

To address these challenges, Deepspatial AI has developed a hybrid deployment model that supports offline-first functionality with periodic sync-based updates. This approach ensures continued usability in remote and low-resource settings affected by limited

connectivity and intermittent electricity supply, while maintaining data integrity, policy compliance, and scalability across diverse administrative contexts.

6. Policy Alignment and Integration

The proposed Gamified Assessments Framework is designed as a policy-aligned, interoperable, and scalable solution to support learning diagnosis and evidence-based decision-making in public school systems. The framework aligns closely with national and global education priorities and is structured to integrate seamlessly with existing digital education ecosystems.

The gamified assessments tool is aligned with the other global/government initiatives:

- **Sustainable Development Goals (SDGs) 4:** Inclusive and equitable quality education.
- **Alignment with Foundational Literacy and Numeracy (FLN) Priorities.**
- **Alignment with National Digital Education Architecture (NDEAR) and Global Analogues.**

At a global level, DSAI technology directly corresponds to international digital education strategies promoted by organizations such as UNESCO, UNICEF, and the World Bank, which emphasize interoperable learning assessment systems, data-informed decision-making, and evidence-based policy formulation. The framework can be adapted to integrate with country-specific learning assessment programs, education management information systems (EMIS), and national learning platforms across low-, middle-, and high-income contexts. Its modular architecture allows governments to embed gamified diagnostics within existing assessment cycles, teacher professional development systems, and student support mechanisms without disrupting current institutional workflows.

7. Scalability and Cost Considerations

A major challenge in ed tech for the public education system is ensuring that innovations are not only impactful but also adaptable, affordable, and sustainable at scale. The proposed gamified assessment frameworks, powered by GeoAI has been designed with these basic principles.

7.1 Cost Efficiency

- The platform delivers per-student annual costs making it one of the most cost-effective diagnostic tools available for large-scale government adoption.

- Low infrastructure requirements (works on basic smartphones, tablets, or shared school devices) reduce barriers for resource-constrained, remote, or challenging geographies.
- Seamless integration with existing government and public-sector digital learning (such as national learning portals, open digital education platforms, and public ICT infrastructure) enables cost-neutral scalability by leveraging already-deployed assets rather than requiring new investments.

7.2 Proven Scalability

- AI-driven analytics reduce the manual workload of educators, providing instant heatmaps, dashboards, and remedial pathways for classrooms and districts.
- The platform has successfully demonstrated scaling across large networks of public schools covering both urban clusters and remote locations, and challenging terrain.
- Deployment model leverages hub-and-spoke training which ensures smooth adoption without heavy external dependence.

7.3 Language and Grade-Level Adaptability

- GeoAI platform supports multi-lingual delivery, aligned with the three-language formula and regional state.
- AI models are pre-trained on diverse student datasets representing socio-linguistic and geographic variations across India, ensuring cultural and contextual inclusivity.
- The assessment and AI analytics pipelines are grade-agnostic, supporting foundational learning stages (early primary stage) through upper-primary and middle-school readiness, making the platform adaptable across educational cycles.

7.4 Pan-National and Global Deployment Potential

With proven adaptability, affordability, and early success rate at scale, the GeoAI-enabled platform positions itself as a viable solution for nationwide and cross-country deployment. The technology enables strategic partnerships with:

- **National and sub-national education authorities** for system-wide learning diagnostics and policy-aligned implementation.
- **Multilateral agencies, development partners, and CSR foundations** to support equity-driven expansion in underserved and marginalized regions.
- **Foundational learning and early-grade literacy and numeracy initiatives** to align with global priorities on learning recovery, foundational skills, and evidence-based education reform.

9. Conclusions:

This white paper explored the application of Deepspatial AI technology, which integrates gamified assessments with artificial intelligence to create an advanced tool for learning diagnosis. The gamified diagnostic platform goes beyond providing engaging learning experiences it functions as a robust diagnostic engine capable of supporting foundational education reform. The GeoAI framework offers a pathway to personalized learning, teacher empowerment, and data-driven governance of the public education system, particularly in low-resource and geographically challenging contexts. By aligning gamified diagnostic assessments with the Nationally defined curriculum and competency frameworks, the platform ensures pedagogical relevance while maintaining systemic scalability across varied policy environments. Through the application of psychometric modelling precisely the Item Response Theory (IRT)–based Graded Response Model the platform accurately analyzes student responses across multiple learning dimensions. This is further enhanced by AI-driven analytics that provide learning outcome tagging, heatmap visualizations, and skill trajectory mapping**,** even in infrastructure-constrained environments. With its scalable infrastructure**,** actionable insights, and policy alignment**,** gamified diagnostics represent a cornerstone for competency-based transformation of education in India and hold potential for replication in other countries. By bridging engagement, diagnostic precision, and systemic reform, this approach provides a sustainable model for reimagining learning assessment in public schools.

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