CiteSaga: Lessons Learned in Serious Game Development for Academic Integrity Education

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Abstract: CiteSaga, a serious game designed for academic integrity education, immerses students in interactive citation challenges. This pedagogical approach offers an engaging alternative to traditional methods in higher education. The development revealed key insights: the necessity of substantial institutional support, interdisciplinary collaboration (including library services for resources), and the persistent resource demands of serious game creation despite AI advancements. While AI can empower smaller teams for narrative richness, faculty engagement differed from students, necessitating targeted training. Prioritizing player engagement, community, and interactive playtesting, drawing from UGC and indie game strategies, proved essential. Moreover, modular design and creative funding addressed budget constraints. CiteSaga demonstrates the potential of serious games for academic integrity, underscoring the need for institutional alignment, stakeholder buy-in, and interactive design. Future research should explore longitudinal impacts, faculty onboarding, and curricular integration.

Keywords: Academic integrity, Game production, Citation education, Serious games, Lessons learned

1. Introduction

The increasing adoption of game-based learning (GBL) strategies worldwide has brought renewed attention to the role of engagement, motivation, and interaction in fostering effective educational experiences (Subhash & Cudney, 2018; Manzano-León et al., 2021). In the South African higher education context, GBL offers promise for addressing entrenched challenges such as large class sizes, multilingual student populations, infrastructural disparities, and varying degrees of academic preparedness (Hu, 2024; Chen, 2025). Yet while digital platforms often dominate GBL discussions globally, local realities necessitate more flexible and context-sensitive approaches, including analogue, low-tech interventions.

One area where traditional pedagogy has struggled to ignite student engagement is academic integrity education, particularly regarding citation practices and the attribution of intellectual work. Students often perceive citation not as a meaningful scholarly exercise but as an arbitrary compliance burden—a perception that undermines foundational academic skills and values. In response, the CiteSaga project was initiated to reframe citation practices as an integral part of knowledge construction, positioning proper attribution as a creative and communal scholarly act rather than a bureaucratic hurdle.

CiteSaga originated as an analogue tabletop serious game designed to bridge motivational gaps in citation education by offering an interactive, narrative-driven learning environment. Developed through interactive prototyping and evaluated with a heuristic framework tailored to serious games ("Play with Purpose"), the project emphasised modularity, accessibility, and the power of user-driven engagement. However, recognising the broader need for scalable, flexible deployment across varied educational contexts, the project later expanded into an experimental digital prototyping phase.

This paper presents critical lessons learned from both the analogue and digital development of CiteSaga. It explores how principles of interactive design, resource-conscious creativity, interdisciplinary collaboration, and emergent AI-assisted practices coalesced into a coherent approach to serious game creation in a resource-constrained higher education environment. In doing so, it offers reflexive insights into not merely the technical facets of serious game development, but also the pedagogical, institutional, and philosophical challenges of integrating GBL into academic integrity education.

2. Contextual Background

Globally, game-based learning (GBL) has demonstrated consistent success in enhancing student engagement, motivation, and academic performance across disciplines (Adam & van den Berg, 2022; Szilágyi et al., 2025). However, effective translation of these approaches into the South African higher education context requires significant adaptation. Large class sizes, multilingual student cohorts, infrastructural inequalities, and varying levels of digital literacy present substantial barriers to conventional digital GBL implementations (Hu, 2024; Chen, 2025). Consequently, there is a growing imperative for educational interventions that are both pedagogically innovative and infrastructurally sensitive.

Within this context, low-tech and analogue GBL strategies have gained prominence as accessible and impactful solutions. Tabletop serious games, in particular, offer unique advantages: they minimise reliance on costly technological infrastructure, encourage face-to-face collaboration, and provide tangible, embodied learning experiences that resonate with assorted student populations. Yet their application to complex academic practices, such as scholarly citation and integrity, remains relatively underexplored.

The CiteSaga project emerged at the intersection of these challenges and opportunities. Initiated in 2023 through interdisciplinary collaboration, the project sought to address a persistent disconnect observed among students regarding the purpose and practice of citation. Rather than framing citation as a mechanical compliance task, CiteSaga aimed to reimagine it as a dynamic and integral part of scholarly identity and knowledge production. Rooted in principles of serious game design, the project emphasised narrative immersion, interactive playtesting, modular construction, and purposeful integration of academic learning outcomes.

Critically, CiteSaga was conceived not as a static artefact but as a flexible pedagogical intervention, capable of evolving alongside institutional needs and technological possibilities. From its inception, the project team recognised the necessity of designing for both present constraints and future scalability—an ethos that would eventually underpin the transition from analogue to digital prototyping in the later stages of development.

3. Development and Evaluation of CiteSaga

The development of CiteSaga as an analogue serious game was intentionally grounded in both pedagogical theory and practical contextual considerations. Recognising the infrastructural limitations facing South African higher education, the project team adopted a low-tech, tabletop format to ensure broad accessibility across student populations. However, accessibility was only one axis of design. Equally critical was the need to embed the learning objectives—specifically, scholarly citation practices—directly into the mechanics and flow of gameplay, ensuring that academic integrity was not peripheral but intrinsic to player engagement.

CiteSaga's development was structured around an interactive prototyping process informed by participatory design principles. Early prototypes were subjected to structured playtesting sessions with student participants drawn from varying academic backgrounds. These sessions provided essential formative feedback, allowing the design team to identify and address points of confusion, disengagement, or misalignment with learning goals.

To guide the development systematically, the team employed the "Play with Purpose" heuristic framework (Bunt et al., 2023), specifically designed for evaluating serious games in educational contexts. This heuristic provided evaluative criteria across key domains such as accessibility, feedback mechanisms, adaptability to different learning contexts, and the quality of the learning experience. Early evaluations revealed, for instance, that players often failed to transfer in-game insights about citation to their formal academic writing unless explicit debriefing sessions were incorporated post-play. As a result, guided reflection activities were added as a standard component of the CiteSaga implementation protocol.

Throughout development, modularity and adaptability were prioritised. CiteSaga was constructed not as a rigid, single-use artefact, but as a flexible learning tool: its rule sets could be adjusted for different class sizes or disciplinary focuses, and its physical components (e.g., citation cards, resource tokens) were designed for easy replication and customization. This modular approach was crucial for ensuring the game's sustainability across variable institutional contexts, particularly in environments where ongoing resource support could not be assumed. Moreover, the development process underscored the critical role of interdisciplinary collaboration. Educational technologists, academic integrity specialists, librarians, and design practitioners all contributed to different facets of the project, reflecting the multifaceted nature of both serious game design and academic

integrity education. Such collaboration not only enriched the game's content but also helped align it with broader institutional priorities, thereby facilitating stakeholder buy-in and potential curricular integration.

Ultimately, the development and evaluation of CiteSaga illustrated the value of interactive, user-centred, and context-sensitive design processes in serious game creation. These foundations would later prove essential when the project expanded into digital prototyping, where similar principles of modularity, interaction, and empowerment through emerging technologies continued to guide the work.

4. Lessons Learned

The development of CiteSaga yielded several critical insights into the process of designing serious games for higher education, particularly within resource-constrained contexts. These lessons, emerging across both analogue and digital phases of the project, extend beyond technical execution to reflect broader principles of educational design, institutional alignment, and participatory pedagogy.

4.1 Learning-Aligned Mechanics

A central design insight was the importance of embedding learning outcomes directly into core gameplay mechanics. CiteSaga's citation challenges were not supplementary tasks but integral to player progress, reinforcing the idea that citation is not an external imposition but part of scholarly strategy. This alignment increased student buy-in and encouraged reflection on the purpose and function of citation practices. Learning was not merely adjacent to play—it was the mode through which players advanced, competed, and collaborated.

4.2 Interaction as Pedagogical Method

Interactive design proved indispensable, both as a technical necessity and as a pedagogical method. Through repeated playtests and feedback loops, misconceptions—such as confusion over citation types or resource use—were surfaced and corrected. These interactions reflected the adaptive learning processes educators aim to foster in students, modelling reflexive practice within the design itself. By embedding interaction into the game's development, the team also enabled ongoing responsiveness to learner needs, institutional contexts, and pedagogical opportunities.

4.3 Accessibility Through Analogue Design

The choice to begin with a physical tabletop format was not a limitation, but a strategic response to infrastructural inequality. Many South African students lack stable internet or personal devices, making digital-first approaches exclusionary. CiteSaga's analogue design ensured accessibility across campuses with varied resources, and encouraged social interaction among players, reinforcing the communal nature of academic practices. This decision underscores the value of low-tech innovation in contexts where digital equity cannot be assumed.

4.4 Structured Reflection and Transfer

Game-based experiences do not automatically translate into improved academic practice. CiteSaga's effectiveness increased significantly when followed by structured debriefing, in which facilitators linked in-game decisions to academic behaviours and institutional expectations. Without these reflection moments, many students failed to generalise from gameplay to their own writing practices. This lesson reinforces the need for deliberate scaffolding to support knowledge transfer—a known challenge in serious games that must be addressed through complementary pedagogical framing.

4.5 Real Costs and Invisible Labour

Despite increasing access to AI tools, the creation of high-quality serious games remains labour-intensive. CiteSaga's development demanded not only game design expertise, but also pedagogical sensitivity, domain knowledge, and interactive testing. The common assumption that AI will dramatically reduce effort obscures the invisible labour of design synthesis, narrative cohesion, interface testing, and institutional coordination. As noted by Colado et al. (2023), AI tools can accelerate processes, but do not replace the need for human insight, interaction, and oversight.

4.6 Empowering Small Teams Through AI

That said, AI tools did play an empowering role, especially in later phases. Generative models such as ChatGPT and image-generation tools allowed the team to rapidly produce narrative content, card art, and interface

mockups, significantly lowering the threshold for experimentation. This mirrors trends in educational development globally, where low-resource teams increasingly leverage AI to access capabilities that would otherwise require specialised skills (Humble, 2024). In this way, AI functioned not as a replacement, but as a creative collaborator.

4.7 Designing Small, Designing Smart

Attempting to create large-scale educational games often leads to inflated scope and diluted outcomes. CiteSaga's strength lay in its modest ambition: a tightly-scoped, well-polished intervention targeting a specific pedagogical need. Drawing inspiration from indie game development models, the project prioritised depth over breadth, interaction over expansion. In resource-constrained academic environments, this approach offers a more sustainable model than attempting to replicate AAA game features at institutional scale.

4.8 Engagement Before Expansion

A recurring insight was that player engagement—and the creation of a sense of community around the game—was more impactful than large-scale distribution. Playtests showed that students were more likely to recommend the game and internalise its lessons when they felt invested in its world and mechanics. This echoes lessons from digital communities: small, highly engaged user groups often generate more meaningful learning outcomes than passive, large-scale deployments (Carson, 2024). Co-design elements, player choice, and in-game reflection all contributed to sustained engagement.

4.9 Modular Design and Sustainable Expansion

Finally, modularity emerged as a key design affordance. By creating discrete, swappable components—such as citation decks, environment cards, or rule variations—CiteSaga could be customised across faculties and disciplines. This modular architecture also supports reusability, enabling different educators to adapt the game without overhauling its core. From a funding and sustainability perspective, such modularity allows components to be incrementally updated or expanded, while enabling the game to fit varying curricular needs.

4.10 Adapt to Funding Challenges

Educational game projects need modular design and creative financing. Often with tight budgets (university grants), maximizing development value is key. Modular, reusable design allows repurposing components across contexts (Carlier et al., 2023). Traditional bespoke games lack knowledge transfer (Carlier et al., 2023). Reusing components creates adaptable core engines, saving costs and easing updates (Sparks, 2019). For higher education, a well-designed platform can serve multiple courses, stretching funding. Creative funding includes government/research grants (NSF, NIH, Horizon Europe) and corporate/NGO partnerships aligning with social impact goals (Liberty, 2023). Sustainable development requires modularity and external funding.

5. Digital Development of CiteSaga

Following the analogue success of CiteSaga, the development team explored a digital extension of the game to increase reach, support asynchronous play, and experiment with new modes of engagement. This digital prototyping phase was guided by the same pedagogical principles underpinning the tabletop version: modularity, accessibility, and interactive design. What distinguished this phase, however, was its embrace of emerging AI-assisted development practices—most notably, the use of "vibe coding" as a novel, intuition-driven approach to rapid prototyping.

5.1 Vibe Coding as Interactive Practice

"Vibe coding," a term popularised by Karpathy (2024), refers to a development approach in which the programmer relies heavily on natural language prompts to co-create functional code with generative AI. Rather than following a rigid software specification, the developer interactively describes goals to the AI—receiving code snippets, testing them, and refining through conversational loops. In this model, the AI acts as a pair-programmer, accelerating development by handling low-level implementation while the human focuses on design intent and user experience.

For CiteSaga, this technique proved especially apt. The project's pedagogical design had already embraced interaction and modularity; vibe coding mirrored this ethos by enabling fast, incremental builds and user-driven interface adjustments. A single developer, equipped with working knowledge of JavaScript and access to ChatGPT, was able to construct a functional digital prototype of CiteSaga in a matter of weeks. Each

gameplay feature—movement, resource tracking, citation resolution—was implemented through successive AI-generated code interactions, interspersed with player feedback and testing.

5.2 Leveraging AI for Empowered Prototyping

The use of generative AI in this context reflected a broader lesson from the analogue phase: small teams can achieve meaningful design outcomes when empowered by the right tools. Where the analogue prototype used modular physical components, the digital version relied on AI to scaffold equivalent modular functions—pop-up prompts, inventory displays, and event handling systems. The developer described desired functionality in plain language, allowing the AI to generate and adapt code in response to playtest issues. This practice aligns with recent findings on AI's role in educational game development, particularly its ability to augment design capacity among non-specialist developers (Colado et al., 2023; Humble, 2024).

Notably, the rapid feedback loop enabled by vibe coding supported agile experimentation. For instance, when testers found it difficult to track resource changes on screen, the developer quickly implemented animated UI feedback by prompting ChatGPT for glowing visual cues. Similarly, when gameplay flow became ambiguous, the AI was instructed to introduce contextual pop-ups guiding player decisions. These features—standard in polished digital games—were integrated into the prototype within hours rather than weeks, demonstrating how vibe coding enhances responsiveness and creative interaction.

5.3 Pedagogical Integrity and AI Oversight

Despite these advantages, the process revealed important limitations. Most critically, AI-generated code does not understand pedagogical nuance. Several early implementations simplified or misrepresented game rules in ways that undermined the intended learning outcomes—for example, auto-completing citation tasks that were meant to provoke player reasoning. This necessitated continuous oversight and alignment with the original game design documents to ensure that the educational intent was preserved.

Moreover, the opaque nature of the AI-generated codebase introduced maintainability risks. Because the developer did not manually write or review every function, debugging complex interactions—such as turn-order logic or event triggers—became challenging. This echoes broader concerns in AI-assisted development literature, where speed gains are often counterbalanced by reduced code comprehension and technical debt (Taeb et al., 2024; Tosi, 2024). In response, the CiteSaga team treated the digital prototype not as a deployable application, but as an experimental proof-of-concept requiring reengineering before broader rollout.

5.4 Rapid Prototyping, Not Final Deployment

The final digital version of CiteSaga successfully replicated the core mechanics of the analogue game, offering single-player functionality, interactive feedback, and guided citation challenges. However, it remained a prototype: fast to build, flexible to test, but not yet production-ready. Its primary value lay in demonstrating how AI-assisted workflows could lower the threshold for educational innovation, particularly in institutions with limited development infrastructure. As such, the digital phase of CiteSaga reinforced the project's central theme: that meaningful educational games can emerge from small teams working interactively, responsively, and creatively—even when technical expertise is limited.

The experience suggests a viable hybrid model for future serious game projects: use AI-augmented prototyping to explore ideas and generate functional builds quickly, then transition to traditional engineering methods for refinement, documentation, and scalability. In this vision, AI is not a shortcut to avoid complexity, but a catalyst that accelerates the early stages of design—allowing educators and instructional designers to lead innovation, rather than remain dependent on specialised development teams.

6. Conclusion

The development of CiteSaga, from an analogue tabletop prototype to an AI-assisted digital interaction, offers a multi-layered case study in serious game design for academic integrity education. In both phases, the project demonstrated how pedagogical goals, contextual constraints, and design pragmatics can be meaningfully aligned through interactive, learner-centred development.

Crucially, the project foregrounded the importance of accessibility—not only in terms of technological reach, but in cognitive and pedagogical design. By embedding citation practices into game mechanics and using gameplay as a medium for conceptual engagement, CiteSaga reimagined citation as a meaningful scholarly act rather than an abstract academic requirement. This reframing proved especially valuable in a South African context, where traditional academic literacy interventions often struggle to connect with student cohorts.

The use of modular, scalable components allowed the game to flex across faculties and contexts, while structured debriefings ensured that in-game learning transferred to academic behaviours. These principles—modularity, reflection, interaction—were later carried forward into the digital phase, where AI-enabled "vibe coding" facilitated rapid prototyping and empowered a small team to extend the game's reach. While this approach raised new questions around oversight, quality, and sustainability, it also pointed to a future in which educators can lead game design initiatives with increasing autonomy and agility.

Taken together, the analogue and digital phases of CiteSaga suggest a coherent and repeatable model for serious game development in higher education: begin with tightly scoped, contextually responsive interventions; design interactively with clear learning goals; and embrace emerging tools not as replacements for expertise, but as catalysts for experimentation and access.

Future research should explore the long-term curricular integration of serious games like CiteSaga, including their effects on academic writing performance, metacognitive understanding of attribution, and institutional attitudes toward playful learning. In parallel, there is a growing need to develop design guidelines and ethical frameworks for AI-assisted game development, particularly in educational contexts where learning integrity is paramount.

Ethics statement: This study did not involve human participants, personal data, or interventions requiring formal ethical clearance. As such, institutional ethical approval was not required.

AI Declaration: AI tools were used to assist in the writing and editing process of this paper, specifically for drafting and refining prose in collaboration with the authors. All ideas, arguments, and scholarly interpretations remain the intellectual work of the authors, with AI serving as a language support and formatting aid. No AI-generated content was accepted without human oversight, critical review, and contextual alignment with the paper's aims.

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