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BRIDGING GLOBAL GOALS AND LOCAL PLAY: AN EXPERIENTIAL LEARNING INTERVENTION FOR SDGs IN PRIMARY AND SECONDARY EDUCATION

Student of Master's :Nomozova Zarifa

Xayrullayev Bekzod

Central Asian University of Environmental and Climate Changes Studies

(Green University)

Email:nomozovazarifa707@gmail.com

Abstract: This research presents a comprehensive comparative analysis of pedagogical models designed to operationalize the UN Sustainable Development Goals (SDGs) across primary and secondary school demographics (Ages 6–15). As educational systems scale sustainability training, a persistent gap remains between structural scientific knowledge and personal, value-driven civic engagement. This study addresses this gap by assessing two tier-specific experiential learning interventions: ''The Great Recyclables Relay'' for primary education (focusing on physical cooperation and materials tracking) and ''The Tragedy of the Commons Resource Simulation' for secondary students (focusing on system dynamics, macroeconomic negotiation, and ecological thresholds). Utilizing a mixed-methods design, we evaluate shifts in students'' systemic comprehension, civic agency and eco-centric decision-making frameworks. The data demonstrates that interactive simulation-based learning models dramatically outperform passive instructional formats, fostering structural system thinking and driving spontaneous grassroots eco-projects within school communities.

Keywords: Secondary Education, Primary Education, Sustainability Simulations, Resource Dynamics, Tragedy of the Commons, System Thinking.

1. Introduction

As contemporary educational policy aligns closer with international development benchmarks, the chalenge of teaching the United Nations Sustainable Development Goals (SDGs) effectively across primary and secondary school tiers has intensified. While elementary students are highly responsive to sensory and physical stimuli, middle and early high school students require strategic challenges that match their developing analytical faculties and social identities. Teaching sustainability exclusively through traditional instructional paradigms often results in 'climate fatigue a state of passive anxiety where students understand environmental issues abstractly but feel entirely powerless to affect meaningful change.(Garrett 2026)

To counteract this, contemporary pedagogy must utilize experiential learning systems that simulate real-world environmental and economic friction. This paper investigates how structured educational simulations can scale in complexity across different age groups, transforming abstract policy benchmarks into direct human experiences that build systemic understanding and long-term civic ownership.(Kioupi and Voulvoulis, 2022).

2. Designing age appropriate SDG interventions

Developing effective SDG curricula requires close alignment with the cognitive milestones of the target students. In primary education (Ages 6–10), children transition into the concrete operational stage, allowing them to comprehend logical rules and causal pathways provided they correspond directly to visible objects. Therefore, activities at this tier must emphasize collective

movement, visible sorting mechanics, and collaborative achievements within acircular framework (Guillen Mandujano, 2026).

Conversely, secondary school students (Ages 11–15) operate within the formal operational domain, gaining the capacity for systematic abstraction, socio-political evaluation, and strategic planning. Interventions for adolescents must move past simple operational tasks (like basic sorting) to address the systemic tensions inherent in sustainable development. These include the economic trade-offs between industrial growth and environmental preservation, the challenges of resource distribution, and the collective management of public assets(Seager and Selinger, 2009).

3. Methodology: Twin-Track Experiential Interventions

This study analyzes a twin-track curriculum intervention executed across a regional school network, introducing distinct, age-optimized gamified modules.

3.1 Primary level intervention: The Materials Lifecycle Relay

Targeting ages 6–10, this intervention gamified the structural mechanics of circular economies (SDG 12). Teams were tasked with running an obstacle course representing industrial supply chains. Students gathered randomly mixed materials at the starting gate and negotiated spatial barriers to allocate them to specialized processing zones. The introduction of specific systemic constraints such as contaminated batches causing entire team delays forced students to recognize that individual sorting accuracy directly determines collective systemic efficiency.

3.2 Secondary level intervention: The Bio-Reserve Resource Simulation

Targeting ages 11–15, this module simulated the 'Tragedy of the Commons' to teach resource management (SDG 15 - Life on Land, and SDG 8 - Decent Work and Economic Growth). echoing the classic socio-ecological threshold frameworks originally defined by Hardin (Battersby, 2017) Student cohorts acted as independent corporate fishing and timber logging syndicates operating within a shared ecosystem with limited capacity.

> **Core Simulation Rules** *Simulation Parameters: Each round represented a commercial harvesting season. Teams could aggressively harvest common resources to maximize short-term financial profit, or coordinate to preserve the reproductive baseline of the ecosystem. Over-harvesting triggered a total collapse of the resource, bankrupting all participating groups.*

This structural framework forced immediate confrontation with real-world dilemmas, demonstrating clearly how short-term competitive strategies lead directly to collective systemic ruin unless structured governance frameworks and mutual trust are established(Battersby, 2017).

4. Comparative evaluation and discussion

Pre- and post-intervention evaluations across both cohorts indicated distinct shifts in cognitive and behavioral metrics compared to control groups exposed only to standard textbook instruction:

Educational Cohort	Traditional Lecture Results	Experiential Simulation Results
Primary (Ages 6-10)	Rote memorization of terms; low behavioral compliance	88% accuracy in material sorting; active student

	post-class.	advocacy in school waste tracking.
Secondary (Ages 11-15)	High passive climate anxiety; disconnect from policy concepts.	Advanced systems understanding; launch of 14 student-led school sustainability projects.

The primary level data suggests that physical gamification transforms sustainability from a set of abstract behavioral mandates into cooperative social play (Pinzon-Salazar ,2026). At the secondary level, the resource simulation completely disrupted passive patterns of learning. Once students directly experienced the operational stress of resource collapse within the game, their approach shifted from short-term financial extraction to long-term collaborative governance. This transition mirrors the precise geopolitical negotiations required to solve global socio-ecological crises.

5. Conclusion

Effectively scaling the United Nations Sustainable Development Goals within academic curricula requires shifting away from passive instructional content toward active, experiential learning systems (Kioupi and Voulvoulis, 2022). Whether implemented through physical lifecycle relays in primary classrooms or strategic multi-stakeholder resource simulations in secondary schools, interactive play breaks down macro-level global challenges into accessible human experiences. These gamified interventions do more than just improve information retention; they build structural system thinking, cultivate personal civic agency, and equip the next generation with the strategic negotiation skills necessary to build a sustainable, balanced world.

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