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PROJECT CARGO MANAGEMENT EDUCATION: INTEGRATING LOGISTIQUEST BOARDGAME INTO TPT555 TO ENHANCE LEARNING OUTCOMES

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Abstract

This study examines the pedagogical integration of *LogistiQuest*, a board-based gamified learning tool, into the Project Cargo Management course (TPT555). Adopting a design-based educational approach, the study explores students' learning experiences and perceptions following a structured gameplay session. Data were collected from 73 third-year undergraduate students using a mixed instrument comprising Likert-scale items and open-ended questions. Descriptive analysis indicates that more than 70% of respondents rated the game as very effective or extremely effective in supporting their understanding of project cargo management concepts, particularly in route planning, strategic decision-making, and risk mitigation. Qualitative feedback further reveals that students perceived the gameplay as realistic, engaging, and supportive of critical thinking, teamwork, and experiential learning. While sustainability-related learning outcomes were less prominent, the inclusion of SDG-aligned mechanics contributed to increased awareness of environmental considerations in logistics decision-making. Overall, the findings suggest that *LogistiQuest* functions as an effective supplementary pedagogical tool that bridges theoretical instruction and practical application in logistics education. The study contributes to the teaching and learning literature by demonstrating the potential of board-based gamification to enhance engagement, strategic cognition, and collaborative learning in project cargo management courses.

Keywords: Experiential Learning Gamification; Logistics Education; Project Cargo

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Management; Strategic Decision-Making

Abstrak

Kajian ini meneliti integrasi pedagogi *LogistiQuest*, sebuah alat pembelajaran berasaskan permainan papan, dalam kursus Pengurusan Kargo Projek (TPT555). Menggunakan pendekatan penyelidikan pendidikan berasaskan reka bentuk, kajian ini meneroka pengalaman dan persepsi pembelajaran pelajar selepas sesi permainan yang berstruktur. Data dikumpul daripada 73 orang pelajar prasiswazah tahun ketiga melalui instrumen gabungan yang merangkumi item skala Likert dan soalan terbuka. Analisis deskriptif menunjukkan bahawa lebih 70% responden menilai permainan ini sebagai sangat berkesan atau amat berkesan dalam menyokong pemahaman konsep pengurusan kargo projek, khususnya dalam aspek perancangan laluan, pembuatan keputusan strategik, dan mitigasi risiko. Maklum balas kualitatif turut menunjukkan bahawa pelajar menganggap permainan ini realistik, menarik, serta menyokong pemikiran kritikal, kerja berpasukan, dan pembelajaran berasaskan pengalaman. Walaupun hasil pembelajaran berkaitan kelestarian kurang dominan, penyertaan mekanik selari dengan Matlamat Pembangunan Mampan (SDG) membantu meningkatkan kesedaran terhadap pertimbangan alam sekitar dalam pembuatan keputusan logistik. Secara keseluruhannya, dapatan kajian menunjukkan bahawa *LogistiQuest* berfungsi sebagai alat pedagogi sokongan yang berkesan dalam merapatkan jurang antara pengajaran teori dan aplikasi praktikal dalam pendidikan logistik. Kajian ini menyumbang kepada literatur pengajaran dan pembelajaran dengan menonjolkan potensi gamifikasi berasaskan permainan papan dalam meningkatkan penglibatan, kognisi strategik, dan pembelajaran kolaboratif dalam kursus pengurusan kargo projek.

Kata kunci: Gamifikasi; Pembelajaran Berasaskan Pengalaman; Pembuatan Keputusan Strategik; Pendidikan Logistik; Pengurusan Kargo Projek

1.0 INTRODUCTION

Teaching tools play a critical role in enhancing learning outcomes, particularly in applied and professional disciplines such as logistics and supply chain management. Traditional lecture-based approaches often struggle to translate abstract concepts into operational understanding, prompting educators to adopt more interactive and experiential teaching tools. Prior studies suggest that experiential and game-based learning approaches can improve student engagement, motivation, and conceptual retention when compared to passive learning methods. The effective management of project cargo plays a pivotal role in global

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supply chain operations, requiring precise coordination of resources, risk management, and sustainability considerations.

Logistics courses, such as TPT555: Project Cargo Management, aim to equip students with a comprehensive understanding of these principles. However, traditional teaching methods often fail to adequately engage students or provide opportunities for hands-on experience with real-world challenges. The use of gamification in education has gained attention in recent years as an innovative approach to enhance learning outcomes, particularly in complex and dynamic fields like logistics and supply chain management (Deterding et al., 2011).

This paper investigates the integration of LogistiQuest, a logistics-themed board game, into the TPT555 course to achieve its stated learning outcomes. The game offers a gamified approach to project cargo management education, incorporating elements such as risk mitigation, KPI assessment, and sustainability practices. The objective is to evaluate how the game facilitates the teaching of course content and supports the development of practical skills needed for the logistics industry**.** This study adopts a design-based educational research orientation, focusing on the pedagogical integration of a board game into logistics curriculum and providing an exploratory evaluation of student perceptions rather than establishing causal learning effects.

2.0 LOGISTIQUEST: GAME OVERVIEW AND PEDAGOGICAL DESIGN

LogistiQuest is a board-based educational game designed to support experiential learning in project cargo management and logistics education. The game simulates logistics operations within a Southeast Asian context, requiring players to plan routes, allocate resources, respond to disruptions, and balance performance objectives with sustainability considerations. Unlike purely entertainment-oriented games, LogistiQuest is intentionally designed as a pedagogical tool aligned with course learning outcomes in Project Cargo Management (TPT555).

Gameplay centres on strategic decision-making rather than procedural execution. Players construct logistics routes using different transport modes, manage limited resources, and respond to crisis scenarios that simulate real-world disruptions such as port congestion or supply chain delays. Performance is evaluated using in-game scoring mechanisms that reflect key logistics considerations, including efficiency, risk mitigation, and strategic planning. Sustainability elements are embedded through SDG-aligned incentives that encourage

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environmentally responsible decision-making.

From a teaching perspective, LogistiQuest functions as a structured experiential learning activity. Students engage directly with logistics problems in a low-risk environment, allowing them to experiment with strategies, evaluate consequences, and learn through iteration. The game is implemented as a supplementary instructional tool, complemented by pre-game briefing and post-game reflection to reinforce theoretical concepts covered in lectures.

2.1 Pedagogical Gamification Framework

The design of LogistiQuest is informed by experiential learning and gamification principles. Drawing on Kolb's Experiential Learning Theory (Kolb, 1984), the gameplay provides concrete experience through active participation, followed by reflection and conceptual linkage facilitated by instructor-led discussion. This learning cycle enables students to translate abstract logistics theories into practical understanding.

Gamification in this context extends beyond the use of a game format. Meaningful game elements such as crisis events, role differentiation through SWOT cards, and performance-based scoring are embedded to promote higher-order cognitive engagement. Consistent with Deterding et al. (2011), these elements are designed to support motivation, challenge, and decision-making rather than superficial engagement.

2.2 Gamification in Logistics and Project Management Education

Previous studies have demonstrated the effectiveness of gamified and simulation-based approaches in logistics and project management education. Classic simulations such as the Beer Game have shown that experiential participation improves learners' understanding of system dynamics and coordination challenges (Sterman, 1989). More recent tools, including port logistics simulations like SimPort-MV2, highlight the value of interactive environments in developing operational and strategic competencies (Tsanakas, Papadimitriou & Nikitakos, 2018).

In project management education, gamification has been associated with improved strategic thinking, problem-solving, and learner engagement (Lehtonen, Aaltonen & Kujala, 2020). These findings suggest that game-based learning environments are particularly suitable for disciplines characterised by uncertainty, trade-offs, and multi-actor coordination,

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conditions that closely resemble project cargo management operations. LogistiQuest builds on this body of work by focusing specifically on project cargo logistics, an area that has received comparatively less attention in gamification research. By emphasising route planning, crisis response, and performance monitoring, the game addresses both operational and strategic dimensions of logistics education.

2.3 Sustainability and Crisis Learning through Gamification

The integration of sustainability and crisis management elements reflects emerging priorities in logistics education. Research indicates that gamified learning environments can raise awareness of environmental trade-offs and support systems thinking when sustainability considerations are explicitly embedded into decision-making processes (Rooney-Varga et al., 2020). However, existing logistics simulations often prioritise efficiency and cost, with limited attention to environmental implications.

Similarly, crisis-based learning has been shown to enhance learners' ability to make decisions under uncertainty and pressure (Almeida, Costa & Jorge, 2016). By incorporating crisis events and SDG-aligned incentives, LogistiQuest exposes students to realistic constraints and competing objectives, reinforcing the complexity of real-world logistics operations. While sustainability learning outcomes may require further reinforcement, the inclusion of these elements represents an important step towards holistic logistics education.

2.4 Curriculum Alignment and Instructional Integration

The integration of LogistiQuest into TPT555 follows the principle of constructive alignment, ensuring coherence between learning outcomes, learning activities, and instructional intent. Gameplay mechanics are deliberately mapped to course learning outcomes related to strategic planning, risk mitigation, performance evaluation, and sustainability awareness. As a result, the game functions not as a standalone activity but as a structured learning intervention embedded within the broader curriculum.

2.5 Integrating LogistiQuest into TPT555 Learning Outcomes

The integration of LogistiQuest into TPT555 follows the principle of constructive alignment, ensuring coherence between course learning outcomes, learning activities, and assessment focus. Table 1 illustrates how LogistiQuest aligns with TPT555 course learning outcomes:

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Table 1. *TPT555 course CLO Integration*

Course Learning Outcome (CLO)	Integration in LogistiQuest Gameplay
CLO 1: Outline the fundamental principles and concepts of cargo project management (C2)	Players learn logistics principles by planning routes, allocating resources, and handling logistical constraints.
CLO 2: Develop strategies to mitigate risks and overcome challenges (C5)	Crisis cards simulate real-world disruptions, requiring players to devise risk mitigation strategies and adaptive solutions.
CLO 3: Identify and assess KPIs for cargo projects (P1)	In-game scoring reflects key KPIs, encouraging players to monitor performance and implement corrective measures.
CLO 4: Evaluate environmental and sustainability impacts (C6)	Players prioritize eco-friendly decisions through SDG objectives, such as reducing carbon footprints and optimizing fuel use.

3.0 Research Design

This study adopts a design-based educational research approach with an exploratory post-intervention evaluation. The primary objective is to examine the pedagogical feasibility and perceived learning value of integrating a board-based gamified tool into a logistics curriculum, rather than to establish causal learning effects. Accordingly, the study focuses on students' learning experiences and perceptions following structured gameplay.

3.1 Participants and Context

The participants consisted of 73 third-year undergraduate students enrolled in the TPT555 Project Cargo Management course under the Bachelor of Transport programme at Universiti Teknologi MARA 4th Semester 2023-2024 Session (October – March 2024), Puncak Alam. All participants were from the same academic cohort and took part in the gameplay activity during the same semester as part of a scheduled instructional session.

3.2 Instructional Procedure

The LogistiQuest game was implemented as a supplementary learning activity within the course. Prior to gameplay, students were briefed on the game objectives, rules, and the linkage between gameplay mechanics and course learning outcomes. Students then participated in a 90-minute gameplay session, during which they engaged in route planning, resource allocation, crisis response, and strategic decision-making.

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Following the gameplay, a short, guided discussion was conducted to encourage reflection on decision outcomes and to reinforce theoretical concepts covered in lectures. This instructional sequence was designed to support experiential learning through action, reflection, and conceptual linkage.

3.3 Instrument Design

Data were collected using a structured questionnaire comprising Likert-scale items and open-ended questions. The instrument was designed to assess five key constructs: student engagement, conceptual understanding, strategic decision-making, sustainability awareness, and perceived learning value. All Likert-scale items were measured using a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Questionnaire items were adapted from established gamification and educational effectiveness literature and contextualised for logistics and project cargo management education. Content validity was ensured through alignment with course learning outcomes and instructor review, Table 2.

Table 2. *Summary of Questionnaire Constructs and Sources*

Construct	No. of Items	Example Item	Source
Engagement	4	"The game made the class more engaging"	Buckley & Doyle (2016)
Conceptual Understanding	5	"Improved understanding of route planning"	Hamari, Koivisto & Sarsa, (2014); Sterman (1989)
Strategic Thinking	5	"Encouraged strategic decision-making"	Lehtonen, Aaltonen & Kujala (2020)
Sustainability Awareness	4	"Considered environmental impacts"	Rooney-Varga et al. (2020)
Learning Value	4	"Bridged theory and practice"	Kolb (1984)

Note: The full questionnaire is available from the authors upon request.

3.4 Reliability and Data Analysis

The internal consistency of the questionnaire was assessed using Cronbach's alpha, with all

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constructs exceeding the acceptable threshold of 0.70, indicating satisfactory reliability. Quantitative data were analysed using descriptive statistics to summarise trends in student responses.

Qualitative data from open-ended questions were analysed using thematic analysis, focusing on recurring patterns related to learning experience, strategic thinking, teamwork, and engagement. Representative student comments were used to illustrate key themes.

3.5 Ethical Considerations and Limitations

Participation in the study was voluntary, and responses were anonymised to ensure confidentiality. As an exploratory classroom-based study, the findings are limited to self-reported perceptions and do not measure objective learning gains. The absence of a control group and pre-test/post-test design is acknowledged, and the results should be interpreted as indicative of pedagogical potential rather than causal impact.

4.0 RESULTS

4.1 Quantitative Results

Figure 1 presents students' perceptions of the effectiveness of LogistiQuest in supporting key learning areas in project cargo management. Overall, the results indicate a strong positive response, with more than 70% of respondents rating the game as very effective or extremely effective across all assessed dimensions.

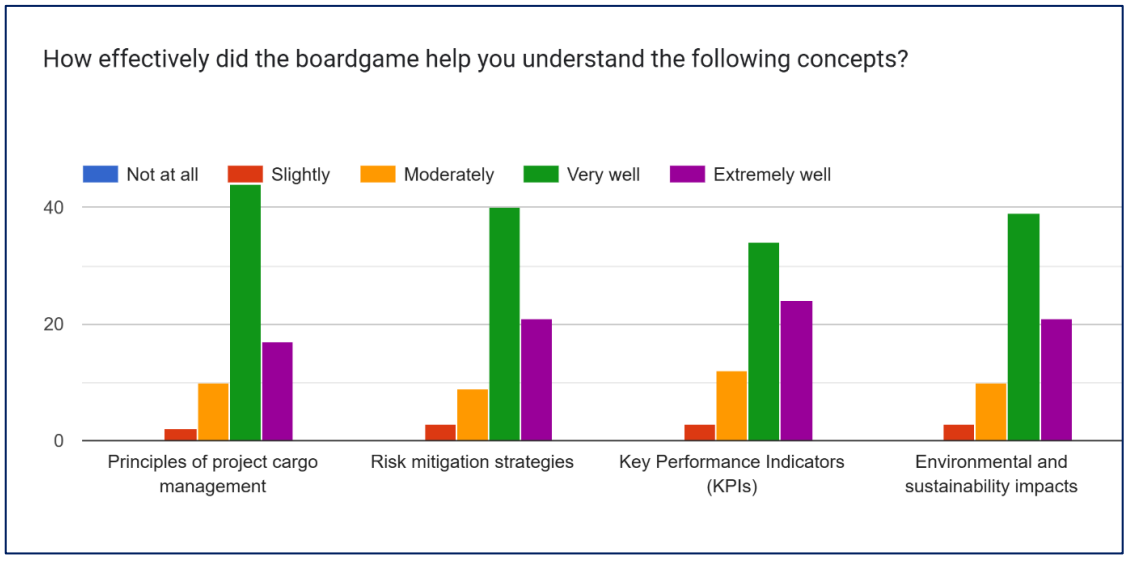

Figure 1. Effectiveness of LogistiQuest

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The highest perceived learning gains were reported for fundamental project cargo management principles, route planning, and strategic decision-making, reflecting close alignment between gameplay mechanics and core course competencies. Students also reported improved understanding of risk mitigation strategies and key performance indicators (KPIs), suggesting that crisis-based gameplay and performance scoring mechanisms effectively reinforced these concepts.

While sustainability-related learning outcomes received comparatively lower ratings, most respondents still indicated moderate to high effectiveness. This suggests that although environmental considerations were recognised during gameplay, operational and strategic aspects were more salient to students' learning experience.

4.2 Contribution of Gameplay Elements to Learning

Figure 2 summarises students' perceptions of which gameplay elements contributed most to their learning. Route planning and network building emerged as the most influential element, followed by resource allocation and SWOT-based strategic roles. Crisis management was also identified as a meaningful contributor, reinforcing the importance of adaptability and contingency planning in logistics operations.

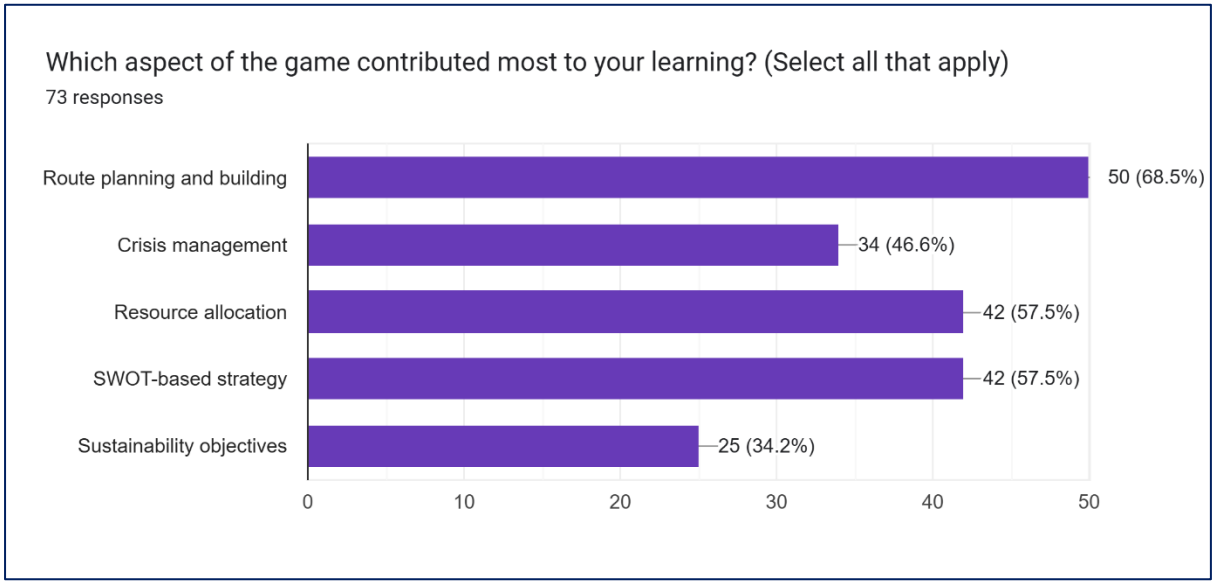

Figure 2. Contribution to Learning TPT555

Sustainability objectives were perceived as less influential compared to operational and strategic components, indicating the need for stronger instructional emphasis or incentives to reinforce sustainability learning within the game.

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4.3 Qualitative Results

Qualitative feedback from open-ended responses further supports the quantitative findings. Thematic analysis identified five dominant themes: experiential learning and realism, strategic thinking, social interaction and teamwork, engagement and enjoyment, and perceived learning value, Table 3.

Students frequently described the gameplay as realistic and reflective of real-world logistics scenarios, noting that it helped them visualise how theoretical concepts are applied in practice. Strategic planning, critical thinking, and decision-making under constraints were repeatedly highlighted, particularly in relation to route optimisation and crisis response. Social interaction and teamwork were also emphasised, with students reporting that collaboration and friendly competition enhanced their learning experience.

Table 3. Summary of Qualitative Themes from Student Feedback

Theme	Description	Representative Student Comments
Experiential Learning	Gameplay supported real-world visualisation of logistics concepts.	"Makes you think as if you were in a real situation."
Strategic Thinking	Students developed planning and decision-making skills.	"To plan a strategy carefully."
Teamwork and Social Interaction	Collaboration enhanced engagement and learning.	"Playing together with friends while learning."
Engagement and Enjoyment	Learning was perceived as enjoyable and less stressful.	"I had fun while learning."
Learning Value	Students recognised the relevance to logistics practice.	"Gain more knowledge in project cargo management."

4.4 Summary of Results

Taken together, the results indicate that LogistiQuest was positively received as a gamified learning tool, particularly in supporting experiential learning, strategic thinking, and collaborative engagement. While sustainability learning outcomes were present but less prominent, the overall findings suggest that board-based gamification can effectively enhance student engagement and perceived understanding in project cargo management education.

5.0 DISCUSSION AND IMPLICATIONS FOR TEACHING AND LEARNING

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This study explored the pedagogical value of integrating *LogistiQuest*, a board-based gamified learning tool, into a Project Cargo Management course. The findings demonstrate that such an approach can enhance experiential learning, strategic thinking, and collaborative engagement in logistics education, consistent with existing research on gamification and experiential learning.

5.1 Experiential Learning and Pedagogical Value

The results indicate that students perceived LogistiQuest as effective in translating abstract logistics concepts into practical understanding. Both quantitative ratings and qualitative feedback suggest that gameplay enabled students to visualise real-world project cargo scenarios, particularly in relation to route planning, resource coordination, and operational constraints. This finding aligns with Kolb's Experiential Learning Theory, which emphasises learning through concrete experience followed by reflection and conceptualisation (Kolb, 1984).

Similar outcomes have been reported in logistics and supply chain education using simulation-based tools such as the Beer Game, where experiential participation improves learners' understanding of system dynamics and coordination challenges (Sterman, 1989). Consistent with gamification literature, the present findings suggest that experiential gameplay can bridge the gap between theoretical instruction and applied learning in complex operational domains (Hamari, Koivisto & Sarsa, 2014).

5.2 Strategic Thinking and Higher-Order Cognitive Skills

A key contribution of LogistiQuest lies in its ability to promote strategic thinking and decision-making under constraints. Students frequently highlighted the need to plan, evaluate trade-offs, and adapt strategies in response to crisis scenarios and limited resources. These findings support prior studies showing that gamified and simulation-based learning environments enhance higher-order cognitive skills, particularly analysis and problem-solving, in project management and logistics education (Lehtonen, Aaltonen & Kujala, 2020; Tsanakas, Papadimitriou & Nikitakos, 2018).

The incorporation of crisis events and role-based strategic differentiation through SWOT cards reflects principles of meaningful gamification, where decision structures mirror real-world complexity rather than superficial game mechanics (Deterding et al., 2011). As such, the game design supports cognitive engagement beyond memorisation, encouraging

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students to adopt strategic and analytical perspectives consistent with professional logistics practice.

5.3 Collaborative Learning and Social Interaction

The prominence of teamwork and social interaction in student feedback underscores the importance of collaborative learning environments in logistics education. Students reported that peer discussion, shared decision-making, and friendly competition enhanced both engagement and understanding. This finding aligns with studies indicating that gamification can support social constructivist learning by facilitating interaction and collaboration among learners (Buckley & Doyle, 2016).

In the context of logistics and project cargo management, where coordination among multiple stakeholders is critical, the development of teamwork and communication skills is particularly relevant. Previous research on logistics simulations, such as SimPort-MV2, similarly highlights the role of collaborative gameplay in reinforcing professional competencies beyond technical knowledge (Tsanaka, Papadimitriou & Nikitakos, 2018).

5.4 Engagement, Motivation, and Learning Environment

Students consistently described the learning experience as enjoyable, engaging, and less stressful compared to conventional classroom activities. This finding is consistent with gamification research suggesting that well-designed game-based learning environments can increase motivation and reduce learning anxiety, particularly in technically demanding subjects (Buckley & Doyle, 2016; Hamari, Koivisto & Sarsa, 2014).

From a teaching and learning perspective, reduced affective barriers may encourage students to experiment with strategies, learn from failure, and engage more deeply with complex content. This supports the argument that gamification, when pedagogically aligned, can create a more inclusive and supportive learning environment rather than merely increasing enjoyment (Deterding et al., 2011).

5.5 Sustainability Learning and Curriculum Integration

While sustainability-related learning outcomes were less dominant than strategic and operational competencies, students nevertheless reported increased awareness of environmental considerations in logistics decision-making. This pattern is consistent with prior studies indicating that sustainability learning through gamification often requires explicit

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instructional reinforcement to achieve deeper cognitive impact (Rooney-Varga et al., 2020).

The inclusion of SDG-aligned mechanics in LogistiQuest represents a meaningful attempt to integrate sustainability into project cargo management education, an area where many existing simulations focus primarily on efficiency and cost optimisation. For curriculum design, this suggests that sustainability elements in gamified learning tools should be explicitly linked to learning outcomes, reflection activities, or assessment tasks to strengthen their educational impact.

5.6 Overall Implications for Teaching and Learning

Collectively, the findings support the growing body of literature advocating the integration of gamification and experiential learning tools in logistics and project management education (Hamari, Koivisto & Sarsa, 2014; Lehtonen, Aaltonen & Kujala, 2020). LogistiQuest demonstrates that board-based gamification can be effectively aligned with course learning outcomes through constructive alignment, supporting experiential, strategic, and collaborative learning within a single instructional intervention.

Rather than replacing traditional teaching methods, board-based games such as LogistiQuest function most effectively as complementary pedagogical tools that reinforce theoretical instruction and promote deeper cognitive engagement. This is particularly relevant in educational contexts where access to digital simulation platforms may be limited, highlighting the continued relevance of low-technology, high-engagement instructional approaches in teaching and learning.

6.0 CONCLUSION

This study examined the pedagogical integration of *LogistiQuest*, a board-based gamified learning tool, into a Project Cargo Management course. Using an exploratory, design-based educational approach, the findings indicate that the game was positively received by students and supported experiential learning, strategic thinking, and collaborative engagement in logistics education.

Both quantitative and qualitative results suggest that gameplay helped students visualise real-world project cargo management scenarios, particularly in relation to route planning, resource allocation, and decision-making under constraints. The incorporation of strategic roles and crisis scenarios further reinforced higher-order cognitive skills relevant to

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professional logistics practice. While sustainability-related learning outcomes were less prominent, the inclusion of SDG-aligned mechanics contributed to increased awareness of environmental considerations in logistics decision-making.

From a teaching and learning perspective, the study demonstrates that board-based gamification can serve as an effective supplementary instructional tool when aligned with course learning outcomes and supported by structured reflection. Rather than replacing traditional instruction, *LogistiQuest* complements theoretical teaching by providing an engaging, low-risk environment for experiential and collaborative learning.

As an exploratory classroom-based study, the findings are limited to student perceptions and do not establish causal learning effects. Future research should incorporate experimental designs, pre- and post-assessment measures, and comparative analyses with other instructional approaches to further evaluate learning impact. Nevertheless, this study contributes to the teaching and learning literature by highlighting the pedagogical potential of board-based gamification in project cargo management education.

6.1 Limitations and Future Research

As a board-based teaching tool, LogistiQuest may face scalability limitations in large classes and lacks real-time data analytics commonly found in digital simulations. Additionally, the reliance on self-reported perceptions limits the ability to infer objective learning gains. Future studies should incorporate experimental designs, pre- and post-tests, and comparative analysis with digital gamification tools.

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