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Gamification in supply chain education: A comparative study of supply chain card games and board games in Malaysian tertiary institutions

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Abstract: Gamification has gained popularity in educational settings as a tool to enhance learning experiences. This research compares two well-known gamification tools, supply chain master card games and supply chain board games, in their capacity to teach supply chain management (SCM) concepts. Random sample interviews were conducted with students and employees to gather their perspectives on the games and SCM topics. The study evaluates the content delivery, level of understanding, and the advantages and disadvantages of using it for teaching and learning in a criteria table. It is aligned with the Sustainability Development Goal (SDG) 4 which is Quality Education in empowering sustainability through quality education. The findings demonstrate that gamification, including the use of these games, positively impacts the teaching and learning of supply chain management in Malaysian tertiary education. The results indicate that both the Supply Chain Card Game and the supply chain board game have significant advantages in enhancing student engagement, experiential learning, and the understanding of key SCM concepts which involve three (3) main measurements which are characteristics, content delivery, and level of understanding. It improves student engagement, facilitates active learning, and fosters essential skill development. The recognition of gamification's potential has led to policy initiatives supporting its integration into the curriculum, aligning with the goals of learner-centered and experiential education. However, challenges remain in implementing gamified learning approaches effectively. The Malaysian government should acknowledge gamification's potential and provide support for teachers to incorporate gamification tools, including training programs, workshops, and educational resources. By addressing implementation challenges, the sustained integration of gamified learning approaches can be ensured in the Malaysian education system. This research emphasizes the significance of gamification in enhancing teaching techniques and its positive impact on student learning outcomes in the field of supply chain management.

Keywords: *Educational environment, Gamification, Supply Chain Board Game, Supply Chain Card Game, Teaching and Learning.*

1. Introduction

Gamification is the use of game design principles, mechanics, and elements in non-game contexts, such as teaching and learning (Tondello et al., 2019). In education, gamification is used to make the learning process more engaging, motivating, and effective by incorporating elements of games, such as

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points, badges, levels, leaderboards, and challenges (Chen et al., 2021). Gamification can be applied to various aspects of teaching and learning, including course content, assessments, and classroom management (Othman et al., 2023). For example, a teacher can create a game-like experience for students by turning quizzes into interactive challenges or by using a leaderboard to display the top performers in a class (Zhang et al., 2019). Gamification can also be used to encourage positive behavior, such as attendance, participation, and completing assignments on time. The benefits of gamification in teaching and learning include increased engagement and motivation, improved retention and recall of information, and enhanced collaboration and social learning (Chen & deNoyelles, 2019). These initiatives aligned with the Sustainability Development Goal (SDG) 4 which is Quality Education in empowering sustainability through quality education. However, it is important to note that gamification should be used thoughtfully and intentionally, as it can also have negative effects if poorly implemented or overused.

The calendar confirms it, we are well into the new century of the digital age, but university classrooms shout OLD SCHOOL. The blackboard is probably white, and there may be a faculty workstation, projector, and screen displaying PowerPoint presentations (Davis, Chen & Hauff, 2020). University students are bored and uninspired in many of today's classrooms. Traditional learning strategies are not successful in the emerging challenges of the technology age. Gamification and the old school of thought in education represent two different approaches to teaching and learning. The old school of thought is characterized by a traditional, teacher-centered approach that emphasizes lecture-based instruction, standardized testing, and rote memorization. Conversely, gamification is a modern approach that uses game-based design and mechanics to make learning more engaging, interactive, and fun. One of the key differences between gamification and the old school of thought is the emphasis on active learning versus passive learning. In the old school of thought, learning is often seen as a passive process where students are expected to sit, listen to lectures, and take notes. In contrast, gamification promotes active learning where students are actively engaged in the learning process, interacting with the material and each other, and receiving immediate feedback on their progress (Kim & Park, 2021).

Several advantages the gamification in the classroom are it will make learning visible through solving problems by making progress visible. It will also increase motivation among learners through the feeling of achievement, social factors through relationships involved in games, and immersion which creates personal experience through role-play and exploration (Atikah et al., 2024). Moreover, gamification develops cognitive development through improving spatial awareness, faster and more accurate attention allocation, and improved mental rotation abilities. This approach is even more give advantage to students who have disability in learning. Some of the gamification that could applied to disability students include the use of game elements such as points, badges, leaderboards, and narratives to motivate students; the application of user-centered design techniques to ensure the accessibility and usability of gamification tools; and the integration of emerging technologies such as virtual and augmented reality, artificial intelligence, and educational robotics to offer immersive and adaptive learning experiences(Jadán-guerrero et al., 2023). Thus, this study evaluates the characteristics, content delivery, level of understanding, and the advantages and disadvantages of using it for teaching and learning in a criteria table.

2. Problem Statement

Business leaders also argue that the new generation of employees does not have enough practical experience when they step into the workplace, requiring a large amount of training to rectify this problem (Selvaraju et al., 2017; Zulfakar et al., 2019; Vatumalae et al., 2022; Vatumalae et al., 2023). A recent concept, known as Gamification, can contribute a solution to this problem. Gamification promotes the use of games and elements of games in education to provide a learning environment to which the youth of today could possibly relate. With gamification, a learning environment for teachers and students, either in the workplace or in the classroom, can be developed to challenge and build on their existing knowledge (Henning et. al., 2017).

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Supply chain management and logistics are key ingredients for success in today's highly competitive global environment (Melati et al., 2023; Sundram, 2011; Sundram et al., 2021; Nurul Syakirah et al., 2020). In traditional education, the content is typically taught using textbooks, handouts, and slides. Because supply chain and logistics management are practical (Mkumbo et al., 2019; Selvaraju et al., 2019; Syammaruthadevi et al., 2023), traditional teaching methods may be less appropriate for such courses, as old-fashioned lectures may bore newcomers and experienced employees. Traditional teaching methods may not cover practical materials and may not stimulate students' desire to learn with a high level of learning efficacy. To overcome these problems, the integration of gaming and education has become a supplement for logistics education (Liu et. al.,2017). The observations of the authors in developing and teaching courses in supply chain management utilizing gamification tools afford a unique viewpoint and roadmap for others regarding teaching supply chain management in academic environments. There is a dearth of research on gamification in education from varied cultural backgrounds, with the majority of studies done in Western environments. Studies evaluating the effectiveness of gamification in various educational systems, cultural norms, and student populations across cultures may be able to uncover general principles behind the efficacy of gamification as well as culturally particular elements.

3. Literature Review

Gamification has gained increasing attention as a potential approach to teaching and learning in various fields, including supply chain management. A number of studies have investigated the effectiveness of gamification in enhancing learning outcomes and engagement in this area. For example, Zhang et al. (2019) conducted a study to assess the impact of interactive video, a gamified teaching approach, on learning effectiveness in an e-learning environment. They found that interactive video was more effective than traditional video in enhancing learning outcomes, suggesting the potential of gamification in improving teaching and learning in online supply chain management courses. Similarly, Chen and deNoyelles (2019) conducted a case study of Kahoot! a gamified learning platform, to explore students' perceptions and behaviors toward online gamified learning environments in a supply chain management course. They found that students perceived Kahoot! as an effective and engaging tool for learning and that it promoted active participation and collaboration among students.

Other studies have focused on specific gamification elements and their impact on learning outcomes in supply chain management courses. For instance, Song et al. (2019) investigated the impact of competition and reward mechanisms on students' learning outcomes in a logistics and supply chain management course. They found that these gamification elements positively influenced students' motivation and learning outcomes. Hamalainen et al. (2020) conducted a systematic review of learning analytics in higher education, including gamification approaches. They found that gamification can improve engagement and motivation among students and that it can enhance learning outcomes in supply chain management courses. In summary, these studies suggest that gamification has the potential to enhance teaching and learning outcomes in supply chain management by promoting engagement, motivation, active learning, and collaboration among students.

The impact of gamification on Malaysia's education policy is an area that has not been extensively researched. However, there are some indications that gamification is gaining recognition as a potential strategy for enhancing teaching and learning in Malaysia. In a study by Daud et al. (2019), which examined the use of gamification in Malaysian higher education, the authors found that gamification can enhance student engagement, motivation, and learning outcomes. The study also suggested that gamification can support the implementation of Malaysia's education policies, particularly in the areas of active learning and technology-enhanced learning. Another study by Azizan et al. (2020) examined the use of gamification in teaching science in Malaysian primary schools. The study found that gamification can improve students' motivation, engagement, and learning outcomes in science education. The authors suggested that gamification can support the implementation of Malaysia's education policies aimed at enhancing science education.

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Although these studies do not specifically address the impact of gamification on Malaysia's education policy, they suggest that gamification can be an effective strategy for enhancing teaching and learning outcomes, which aligns with Malaysia's education policies. In recent years, Malaysia has emphasized the importance of 21st-century skills, including critical thinking, creativity, and problem-solving, in its education policies (MOE, 2015). Gamification can support the development of these skills by promoting active and interactive learning. Overall, while further research is needed to fully understand the impact of gamification on Malaysia's education policy, these studies suggest that gamification has the potential to enhance teaching and learning outcomes in alignment with Malaysia's education policies.

4. Methodology

There are various methodologies that can be used to evaluate card games and board games for teaching and learning. One commonly used methodology is the Kirkpatrick model, which evaluates the effectiveness of training programs at four levels: reaction, learning, behavior, and results (Kirkpatrick, 1996). Another methodology is the Game Experience Questionnaire (GEQ), which measures the player's gaming experience in terms of emotional, cognitive, and sensory engagement (IJsselsteijn et al., 2008). The GEQ has been used to evaluate the effectiveness of serious games, including educational games, in various contexts.

The advantage of using the Game Experience Questionnaire (GEQ) over the Kirkpatrick model in teaching and learning is that the GEQ provides a more detailed and nuanced understanding of the player's gaming experience (Boyle et al., 2012; Hamari & Koivisto, 2015). While the Kirkpatrick model evaluates the effectiveness of training programs at four levels, including the learner's reaction, learning, behavior, and results, it does not specifically focus on the gaming experience itself. In contrast, the GEQ is specifically designed to measure the player's emotional, cognitive, and sensory engagement during gameplay, providing a more in-depth understanding of the game experience. This can be particularly useful in evaluating serious games and educational games, where the primary objective is not just to impart knowledge or skills, but also to engage the learner and enhance their motivation and interest.

Moreover, the GEQ has been extensively validated in various contexts, including educational games, and has been found to be a reliable and valid measure of the gaming experience (Ijsselsteijn et al., 2008; Nacke et al., 2017). This means that it can provide a standardized and consistent way of measuring the effectiveness of games for teaching and learning, allowing for comparisons across different games and contexts. However, it should be noted that the GEQ and the Kirkpatrick model are not mutually exclusive, and can be used in conjunction with each other to provide a more comprehensive evaluation of the effectiveness of games for teaching and learning (Lumsden et al, 2016; Nacke & Deterding, 2017).

Supply Chain Card Game and Supply Chain Board Game were chosen as gamification tools for teaching and learning supply chain management; the main scenario and features were detailed. Following an exploratory qualitative literature search on chosen card and board games, the acquired data is clarified and grouped into sections entitled a) Game characteristics, b) Game content delivery, c) Level of understanding, and d) the advantages and disadvantages in using it for teaching and learning.

4.1. Research Design and Sampling

This study adopted qualitative approach through face-to-face interview. In parallel, our research conducted 15 random interviews with university students in Puncak Alam and corporate workers who had played and experienced the games to validate our results and contribute fresh common experienced information to our data. The sampling chosen for the people who has experience in games to achieve the research objective. Qualitative research requires number of respondents based on the research intention which the samples need to be selected as a rational cross-sectional individual (Narayanan et al., 2024a; Narayanan et al., 2024b). According to Bolderston (2012),The number of participants can be considered from 10 individuals to a maximum of 50-60 in the majority of interviews. Finally, based on our

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observations, the game qualities are graded in terms of their relevance in teaching SCM. The comparison and conclusion sections would detail the game's merits and flaws.

5. Findings

The research findings provide valuable insights into the characteristics, content delivery, level of understanding, and advantages and disadvantages of the Supply Chain Card Game and the board game. Both games offer unique features and cover a wide range of supply chain concepts, enhancing players' comprehension of the subject. The games provide clear illustrations, promote experiential learning, and increase student engagement. However, potential challenges include game complexities and the time investment required by instructors. Overall, these findings demonstrate the value of using gamification tools in teaching supply chain management, while also highlighting areas for improvement and consideration.

5.1. Characteristics

Table 1.
Time Characteristics.

Time characteristics	Supply chain master card game	Supply chain board game
Setup time	5 min	15 min
Debrief duration	15 min	45 min
Game duration	30 min	4 hours
Ideal workshop duration	1 day	2 days

1. Setup Time:
   The shorter setup time of the Supply Chain Card Game indicates that it has a more streamlined and efficient setup process. This can be beneficial when time is limited, allowing participants to quickly get into the game and start learning.
   The longer setup time of the Supply Chain Board Game suggests that it may have a more complex setup, potentially involving the arrangement of game components, boards, cards, or tokens. This may provide a more immersive and detailed experience for participants.
2. Debrief Duration:
   The shorter debrief duration of the Supply Chain Card Game implies that the key takeaways and lessons from the game can be discussed and summarized more efficiently. This could be advantageous in situations where time is limited or when a concise debrief is preferred.
   The longer debrief duration of the Supply Chain Board Game indicates that it offers a more comprehensive and detailed discussion of the game outcomes, strategies, and supply chain concepts. This allows for a deeper analysis and reflection on the participants' decisions and their impact on the supply chain dynamics.
3. Game Duration:
   The shorter game duration of the Supply Chain Card Game suggests that it is designed to provide a condensed simulation of supply chain scenarios. It may focus on specific aspects or challenges of the supply chain, allowing participants to gain insights and make decisions in a relatively short period.
   The significantly longer game duration of the Supply Chain Board Game implies a more extensive and intricate supply chain simulation. It offers a more immersive experience where participants can explore various scenarios, strategies, and the complexities of managing a supply chain over an extended period.
4. Ideal Workshop Duration:

The shorter ideal workshop duration for the Supply Chain Card Game indicates that it is suitable for workshops or training programs with limited time available. It can be incorporated into shorter sessions or as a part of a larger program covering multiple topics.

The longer ideal workshop duration for the Supply Chain Board Game suggests that it is intended for more in-depth workshops or training programs where a significant amount of time can be devoted to exploring and understanding complex supply chain dynamics. It allows participants to engage deeply with the game, learn from the experience, and discuss strategies and outcomes in detail.

In summary, the Supply Chain Card Game offers a quick and concise supply chain gaming experience. It has a shorter setup time, shorter game duration, and requires less time for debriefing. It is suitable for shorter workshops where time is limited. On the other hand, the Supply Chain Board Game provides a more comprehensive and immersive supply chain simulation. It requires more time for setup, has a significantly longer game duration, and involves a more extensive debriefing process. The board game is well-suited for longer workshops or training programs that aim to delve deeper into supply chain concepts and strategies. These interpretations highlight the trade-offs between efficiency and depth in the two games. The Supply Chain Card Game offers a quicker and more concise experience, while the Supply Chain Board Game provides a more immersive and detailed exploration of supply chain management. The choice between the games depends on the specific objectives, time constraints, and desired level of engagement for the workshop or training program (Cha & Lee, 2021).

5.2. Content Delivery

Table 2 shows the comparison between both card games and boardgame in terms of content enrichment or delivery based on the result of an interview and observation remark. The ranking of the score is based on vision related to teaching technic importance and value (With the same ranking as the previous part, with high coverage of 5 points, mid as 3, and low as 1 point).

Table 2.
Comparison in terms of content delivery.

No	Concepts and terminologies covered	Supply chain card game	Supply chain board game
1	Build to order	5	4
2	Bullwhip effect	5	5
3	Collaborative planning, forecasting & replenishment	4	4
4	Cross sourcing	5	3
5	Cross-docking	5	5
6	Decoupling point	5	3
7	Demand-driven supply chain	5	4
8	Drop shipping	5	4
9	Electronic data interchange	5	4
10	Just-in-time	5	4
11	Last-mile delivery	5	5
12	Lead time	4	5
13	Milkrun	5	5
14	Order cycle time	5	4
15	Postponement	5	5
16	Quick response	5	3
17	Reverse logistics	5	5
18	Service level agreement	5	4
19	Supplier relationship management	5	4
20	Supply chain analytics	5	5

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No	Concepts and terminologies covered	Supply chain card game	Supply chain board game
21	Third-party logistics (3PL)	5	4
22	Value steam mapping	4	5
23	Vendor managed inventory	4	4

The remaining concepts and terminologies follow a similar pattern of coverage between the two games. In general, both the Supply Chain Card Game and the Supply Chain Board Game provide comprehensive coverage of a wide range of supply chain concepts and terminologies. However, there are slight differences in coverage for certain concepts, with some concepts being covered more extensively in one game compared to the other.

1. Consistency of Coverage:
   Both the Supply Chain Card Game and the Supply Chain Board Game show a consistent and high level of coverage for several key concepts such as the bullwhip effect, cross-docking, last-mile delivery, milk-run, reverse logistics, and supply chain analytics. These concepts are crucial in understanding and managing supply chain dynamics, and both games effectively address them.
2. Variations in Coverage:
   There are some variations in coverage between the two games for certain concepts. For example, the Supply Chain Card Game tends to have higher coverage for concepts like build-to-order, cross-sourcing, drop shipping, and just-in-time, compared to the Supply Chain Board Game. This suggests that the card game may offer more detailed insights or scenarios related to these concepts.
3. Level of Complexity:
   The Supply Chain Board Game appears to cover concepts like lead time, postponement, value stream mapping, and vendor-managed inventory with a higher score than the Supply Chain Master Card Game. This suggests that the board game might provide a more in-depth exploration of these complex supply chain concepts, potentially incorporating them into the gameplay mechanics or decision-making processes.
4. Balanced Coverage:
   Overall, both games provide balanced coverage of a wide range of supply chain concepts and terminologies. They cover various aspects such as inventory management, logistics, customer demand, supplier relationships, and technology-enabled solutions like electronic data interchange (EDI). This ensures that participants gain a comprehensive understanding of different elements within the supply chain ecosystem.
5. Alignment with Teaching Objectives:
   The ranking of content delivery in both games reflects their alignment with the teaching objectives and the importance placed on each concept from a teaching perspective. Concepts that are deemed critical or fundamental to supply chain management, such as the bullwhip effect or last-mile delivery, receive high scores in both games, indicating their significance in the learning process.
6. Consideration for Audience and Workshop Goals:
   When choosing between the two games, the variations in content delivery should be considered based on the target audience and the specific goals of the workshop. The Supply Chain Card Game may be more suitable for introductory or shorter sessions, offering a quick overview of a wide range of concepts. On the other hand, the Supply Chain Board Game may be better suited for more advanced workshops or programs that require a deeper exploration of complex supply chain dynamics.

   These analytical interpretations provide insights into the strengths and focus areas of each game in terms of content delivery. Ultimately, the choice between the Supply Chain Card Game

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and the Supply Chain Board Game depends on the specific learning objectives, the target audience, and the desired depth of understanding of the supply chain concepts being taught.

5.3. Level of Understanding

Based on the comparison provided in Table 3, which evaluates the level of understanding of key supply chain concepts and terminologies after playing the Supply Chain Card Game and the Supply Chain Board Game, here is an analytical interpretation:

1. Consistent Understanding:
   Both the Supply Chain Card Game and the Supply Chain Board Game demonstrate consistent levels of understanding across several concepts, such as build-to-order, bullwhip effect, cross-sourcing, cross-docking, order cycle time, service level agreement, and third-party logistics (3PL). These concepts are effectively conveyed in both games, resulting in similar levels of player enhancement of understanding.
2. Higher Understanding of Board Games:
   The Supply Chain Board Game consistently achieves higher levels of understanding for several concepts, including collaborative planning, forecasting and replenishment (CPFR), decoupling point, demand-driven supply chain, electronic data interchange (EDI), just-in-time (JIT), lead time, postponement, supply chain analytics, value stream mapping, and vendor-managed inventory. Players of the board game are more likely to develop a deeper understanding of these concepts compared to players of the card game.

Table 3.
Comparison in terms of the Level of Understanding.

No	Concepts and terminologies covered	Supply chain card game	Supply chain board game
1	Build to order	4	4
2	Bullwhip effect	5	5
3	Collaborative planning, forecasting and replenishment	3	5
4	Cross sourcing	4	4
5	Cross-docking	4	5
6	Decoupling point	3	4
7	Demand-driven supply chain	3	4
8	Drop shipping	4	5
9	Electronic data interchange	3	4
10	Just-in-time	5	4
11	Last-mile delivery	5	5
12	Lead time	4	5
13	Milkrun	5	5
14	Order cycle time	4	4
15	Postponement	4	5
16	Quick response	5	5
17	Reverse logistics	5	5
18	Service level agreement	4	4
19	Supplier relationship management	5	5
20	Supply chain analytics	4	5
21	Third-party logistics (3PL)	5	4
22	Value steam mapping	4	5
23	Vendor managed inventory	4	5

3. Comparable Understanding:

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For concepts such as drop shipping, milk-run, quick response, reverse logistics, supplier relationship management, and build-to-order, both the Supply Chain Card Game and the Supply Chain Board Game provide comparable levels of player enhancement of understanding. Players of both games are likely to grasp these concepts effectively.

4. Overall Effectiveness:

   Both games exhibit a strong ability to enhance players' understanding of supply chain concepts and terminologies. The level of understanding achieved through gameplay indicates that both the Supply Chain Card Game and the Supply Chain Board Game can be valuable tools for facilitating learning and comprehension in the field of supply chain management.

5. Board Game Complexity Advantage:

   The higher level of understanding achieved in the Supply Chain Board Game for certain concepts may be attributed to its more extensive gameplay mechanics and immersive nature. The board game allows players to engage in complex decision-making processes and experience the consequences of their choices, contributing to a deeper understanding of supply chain dynamics. This statement is supported by Bayeck (2020) which mention that board games are spaces for mathematical learning and enable the players in learning of various contents. This activity allows for various interactions that result in players engaging in computation thinking, teamwork and creativity.

6. Card Game Simplicity Advantage:

   The Supply Chain Master Card Game, while achieving slightly lower levels of understanding for some concepts, offers a simpler and more streamlined gameplay experience. This can be advantageous for introducing beginners to supply chain concepts or for situations where a quicker overview of multiple concepts is desired.

Overall, both the Supply Chain Card Game and the Supply Chain Board Game effectively enhance players' understanding of key supply chain concepts and terminologies. The board game, with its more immersive and complex nature, tends to provide a higher level of understanding of certain concepts. However, the card game excels in simplicity and efficiency, making it a valuable introductory tool for covering a broader range of concepts in a shorter timeframe (Lumsden *et al.*, 2016).

5.4. Advantages and Disadvantages

While the advantages highlight the potential benefits of using these games in the classroom, the disadvantages emphasize some challenges and considerations that need to be addressed for successful implementation. With proper planning, training, and support, the advantages can be maximized, and the disadvantages can be mitigated to create a valuable learning experience for students (Arreola-Risa et al., 2019).

Table 4.
Advantages and disadvantages of gamification tools.

No	Advantage	Disadvantage
1	A clearer illustration of key supply chain concepts and terminologies issues	Complexities of the master card game and the supply chain board game
2	Enhanced experiential learning activities	Restrictions on usage
3	Greater instructor control of classroom content	Support at the academic institution
4	Enhanced student participation in class	Large time investment by the instructor

5.5. Advantages

1. Clear Illustration of Key Concepts: Both the Supply Chain Card Game and the Supply Chain Board Game offer a clearer illustration of key supply chain concepts and terminologies.

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Through gameplay and interactive components, participants can visualize and understand these concepts in a practical context.

2. Enhanced Experiential Learning: The games provide experiential learning activities that go beyond theoretical lectures or discussions. By actively participating in the games, students can apply their knowledge, make decisions, and experience the consequences, fostering a deeper understanding of supply chain dynamics.
3. Instructor Control: The games offer greater instructor control over the classroom content. The instructor can customize the gameplay, adjust scenarios, and guide discussions to focus on specific learning objectives or areas of emphasis. This control enables a more tailored learning experience for the students.
4. Student Participation: The games enhance student participation in class. They create an engaging and interactive environment where students can collaborate, compete, and contribute actively. This active participation promotes knowledge retention and encourages students to think critically and apply their understanding.

5.6. Disadvantages

1. Complexities of the Games: Both the Supply Chain Card Game and the Supply Chain Board Game may have inherent complexities. Understanding the rules, mechanics, and strategies of the games may require some initial effort from the students. This complexity can be a challenge, especially for those who are new to supply chain management or board/card games.
2. Usage Restrictions: Depending on the academic institution or context, there may be restrictions on the usage of games in the classroom. Some institutions may have specific guidelines or limitations on incorporating games as teaching tools, which can limit the availability or feasibility of using these games.
3. Support at the Academic Institution: The implementation of the games may require support from the academic institution. This support can include providing necessary resources, materials, or technical assistance to ensure a smooth and effective integration of the games into the curriculum.
4. Time Investment by the Instructor: Utilizing the games effectively requires a significant time investment from the instructor. They need to familiarize themselves with the rules, mechanics, and learning outcomes of the games, as well as prepare and facilitate the gameplay sessions. This time commitment can be demanding, particularly for instructors with heavy teaching loads or limited resources.

6. Discussion and Conclusion

The findings of this study shed light on the effectiveness of gamification tools, specifically the Supply Chain Card Game and the supply chain board game, in teaching supply chain management (SCM) concepts (Siti Noor Roseamirah *et al.*, 2020). Through the comparison of these two gamification tools, it was possible to identify their advantages and disadvantages in terms of user-friendliness and educational impact. The random sample interviews conducted with students and employees provided valuable insights into the perspectives and impressions of players regarding the games and their views on SCM topics. This qualitative data complemented the quantitative evaluation of the games' characteristics in the criteria table. By considering both the subjective experiences of the players and the objective assessment of the games' content coverage, delivery, and level of understanding, a comprehensive analysis of the gamification tools was achieved.

The results indicate that both the Supply Chain Card Game and the supply chain board game have significant advantages in enhancing student engagement, experiential learning, and the understanding of key SCM concepts. These gamification tools provide a more interactive and immersive learning experience, allowing students to apply their knowledge in realistic scenarios (Krajewski & Ritzman, 2020). The collaborative nature of the games also fosters teamwork and communication skills among players. However, it is important to note that certain weaknesses were identified in the user-friendliness

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and complexity of the games. The supply chain board game, while offering a more in-depth understanding of SCM concepts, may require a larger time investment and a higher level of complexity, which could pose challenges for some users. On the other hand, the Supply Chain Card Game provides a simpler and more streamlined experience, which may be more suitable for introductory purposes or when covering a broader range of concepts within a shorter timeframe.

In summary, the adoption of gamification tools such as the Supply Chain Card Game and supply chain board game has proven effective for educating and enhancing understanding of supply chain management within Malaysian tertiary education. These tools foster active learning, engagement, and skill development, in line with learner-centered education objectives. The study's findings underscore the importance of ongoing support and resources to integrate gamified learning methods into the curriculum. It is imperative for the Malaysian government to acknowledge the educational potential of gamification and implement policy initiatives to encourage its widespread adoption. This support should encompass training programs, workshops, and the provision of educational materials tailored to gamified learning approaches.

While the Supply Chain Card Game and the supply chain board game have distinct advantages and disadvantages, they both offer valuable teaching techniques for SCM concepts (Lu, *et al.*, 2020). Educators should consider the specific learning objectives, time constraints, and target audience when selecting the appropriate gamification tool. Overall, this research contributes to the growing body of knowledge on the effectiveness of gamification in education and provides insights into the application of gamification tools in teaching supply chain management. Further research could explore the long-term impact of gamified learning approaches on student performance and career outcomes in the field of supply chain management.

7. Suggestion for Future Research

Future research endeavors should explore the long-term impact of gamified learning approaches, such as the Supply Chain Card Game and supply chain board game, on students' performance and career outcomes in the field of supply chain management. By assessing the extent to which the gamification experience translates into practical skills and improved job prospects, researchers can provide valuable insights into the sustained benefits of gamified learning. Additionally, conducting a comparative analysis across different disciplines and subjects would shed light on the effectiveness of gamification in diverse educational contexts. This comparative exploration would help identify the specific benefits and limitations of gamified learning, paving the way for tailored and targeted implementation strategies across various academic domains. By delving into these areas, future research can contribute to a comprehensive understanding of the long-term impact and effectiveness of gamification in education.

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