Digital Versus Analogue Multiplayer Gaming: Comparing Learning Outcomes

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Digital Versus Analogue Multiplayer Gaming: Comparing Learning Outcomes

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Abstract In this study, we explore the similarities and differences in learning effects produced by playing a digital and an analogue version of the disruption management game for container terminal operations. We organized the analogue game sessions with students in the United States and digital game sessions with students from Greece. We analysed a postgame survey that captured the learning experiences of the participants to compare the differences and similarities of the learning effects of either game. Based on the results, we conclude that the type of game has limited effect on the learning experience, while incorporation or exclusion of learning principles does have.

Keywords Analogue games · Communication · Container terminal operations · Digital games · Disruption management · Information sharing · Learning

1 Introduction

A lot has been written about the use and effectiveness of digital [1] and analogue games [2] as game-based learning method. Digital games and board games have stark differences in terms of production time, costs as well as ease of use. However, comparisons between the learning effect of digital and nondigital simulation games are rather underdeveloped. The immense popularity of digital entertainment games suggests that players enjoy playing games, and these positive emotional experiences can themselves be viewed as positive outcomes of playing games [3]. Board games provide, especially for group play, the spatial structure, social setting and physical interactions [4].

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In this study, we explore the differences in learning effects produced by a digital and an analogue game on students with respect to information management and communication in complex and dynamic situations that require collective problem solving. We will provide the background and description of the games used in our study in the following section.

2   The Disruption Games: Digital and Analogue Versions

Both games under study are named disruption management game and are set in the ambience of container terminal operations. We will provide a side-by-side description of both versions since the underlying principles and game mechanics are similar in both games. Before delving into the games, we provide the background and objective of these games.

2.1   Background: Disruptions in Container Terminals

Container terminals are crucial hubs in the global transportation network of goods that act as coupling and decoupling points for the transfer of containers from sea to land and vice versa. The storage area of the terminal is called the yard, where containers are stored in stacks, thus facilitating the decoupling of seaside and landside operations [5]. Planning and aligning all functions in a container terminal is a difficult task [6]. All planning activities of the terminal are interrelated, and changes in one plan have a big influence on other plans [7].

Container terminals are often affected by a wide range of disruptions like common equipment failures, sudden demand shocks, weather conditions, conflicts and political unrest or even terrorism [8]. Each of these aspects, described for instance [9, 10], can have debilitating ripple effects on the container terminal, causing financial, operational or collateral losses and in rare cases affecting human operator safety [11]. Container terminals have to battle these disruptions and prevent the negative effects by focusing on disruption mitigation by enabling integrated planning through effective information management. These challenges form the basis for the learning objectives of a game to teach participants on the importance of information management for integrated and collective problem solving towards effective disruption mitigation in container terminal operations. In our games, players explore the role of expert in dealing with disruptions especially from an information sharing perspective.

We chose to develop a board game first because it was the most cost effective, flexible and social platform to represent multiple perspectives and information sharing challenges in integrated planning operations. Both the digital and analogue ver-

sions of the disruption management games were designed based on the triadic game design approach of balancing the aspects reality, meaning and play [12].

2.2 Board Game

The board game is a multiplayer game that consists of five different roles (berth planner, vessel planner, control tower operator, resource planner and sales) [13]. Each role (excluding the game master) is responsible for specific planning and operational tasks in the container terminal. A facilitator gives feedback about player decisions after every round. The game board and cards are illustrated in Fig. 1. See [14] for a detailed description of the roles and rules of the game.

2.3 Digital Game

The digital game is a quasi-multiplayer version that is played by a single player. It consists of three roles (control tower operator, berth & vessel planner and sales). The player can choose one of the three roles, while the other two are automated. The other two roles are simulated in the game. These roles respond to the decisions of the player. The decisions of the automated players are modelled in decision trees, where the choice of the automated player depends on the type of information he or she receives. The player receives feedback whether their action or shared information was useful or not. We also introduced an element of randomness in the automated player choices in order to avoid 100% rational decision-making which is not realistic among human beings. The reasons to choose a quasi-multiplayer and role
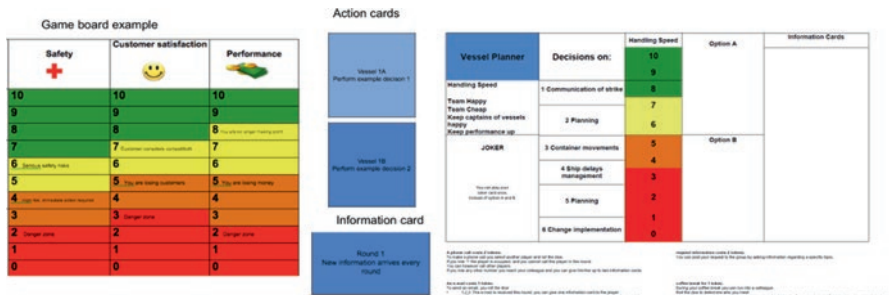

Fig. 1 Left side, overall game board of the disruption management board game; right side, individual game board of the disruption management board game
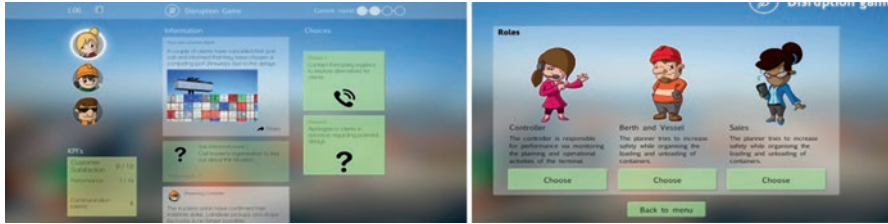
Fig. 2 The digital version of the disruption management board game

reduction are explained in detail in [15]. There is no facilitator needed. Figure 2 shows some screenshots of the digital version of the disruption management game.

2.4   Game Play

As the games unfold, disruptions start occurring that drastically affect individual operations as well as the operation of the entire organization. Three disruption scenarios, each with varying levels of severity, have been modelled in both games.

The objective of the players in both games is to maintain healthy levels of three main key performance indicators of the terminal, namely, safety, customer satisfaction and performance during different rounds. With each round of the game, the event complexity increases, and the disruption situation escalates, unless some action by the players is taken. In order to make the 'right' decision and 'win' the game, participants need to manage information, communicate and coordinate if necessary, monitor the effects of disruptions and take the necessary actions at the right time to mitigate the negative effects.

3   Research Methodology and Design

3.1   Experimental Set-Up

The overall design of the game sessions for both the digital and analogue version had similarities in terms of location, briefing and debriefing. Both game sessions were carried out in classroom settings. Every game session of the disruption management game began with a nondigital face-to-face briefing usually lasting 20–25 min. The various intermodal operations, terminal processes, roles in the container terminal and the equipment used were described in this stage.

For the board game, the game session adopted, participants were gathered around a table in a spacious room. The room was prepared in advance for the play, by prearranging the required game objects. Depending on the size of the group, one or more

Fig. 3 The classroom setting of board game play and digital game play

game facilitators orchestrated the game play. The game facilitator was given a game manual that describes the role and the method of orchestration.

The digital game required that players use computers and a mouse to play the game in their classroom. The game interface was self-explanatory, and the role of the facilitator was only limited to briefing and debriefing and technical assistance in case of computer failure. An overview on the different game play sessions is depicted in Figure 3. The players played the game individually, and they could play the game several times from different role perspectives.

After five rounds of game play, the game session was concluded with a debriefing session, where the game facilitator explained the principles of disruption management, the challenges faced by practitioners, the relationship of the game elements to the said challenges, the progress of the game play, a review of the scores and the reasons for obtaining these scores, potential alternative strategies, a comparison between scores of different play groups and the reasons for the differences, etc.

After the debriefing session, the game facilitator encouraged the participants to provide feedback about the game and their own learning experience, after which the players had to answer a postgame survey about their learning experiences. The questions consist of interval questions about preparation of future work and understanding information sharing and an open question about their perceived learning. The students received partial course credit for their participation. We will discuss the results of the survey in the following section for both games.

3.2 Sample

A first experimental set-up of the board game was conducted with 80 bachelor students majoring in supply chain, logistics and transportation at a large university in the United States (see Table 1). The sample during the game play with the digital

Table 1 Detailed information about the sample

	Board game	Digital game
Number of participants	80	30
Background	Students USA	Students Greece
Number of completed surveys (response rate)	44 (55%)	29 (97%)

version consisted of 30 master students majoring in transportation at a Greek university. Although the groups came from different countries, the students studied the same subject, and neither group had much professional experience with risk management.

4   Results: Learning Outcomes of the Two Games

The postgame survey questions focused on the learning experiences of the student participants after the gaming session, regarding the preparation for future work information sharing.

4.1   Preparing for Future Work

To assess the impact of the games, we asked the players if the learning principles (information sharing, communication, teamwork, etc.) of the disruption management game would prepare and help them to handle real-world disruptions as future supply chain professionals (see Fig. 4).

From the survey data of the **board game**, about 16% of the students responded that it would be *very helpful*, 36% of the participants felt that the learning experience from the game would be *helpful*, and 39% felt that it would be *somewhat helpful*, and 9% answered *slightly helpful* to better prepare them to handle real-world disruptions. Not even one participant responded that it would be not helpful.

With respect to the respondents of the **digital game**, 14% reported that it would be *very helpful*, 34% felt that it would be *helpful*, 31% felt *moderately helpful*, 7% felt that it would be *slightly helpful*, and 14% felt that it was *not helpful*.

Fig. 4 Comparison between analogue and digital version on the question if the game contributes for their future profession (1 = not helpful, 5 = very helpful)
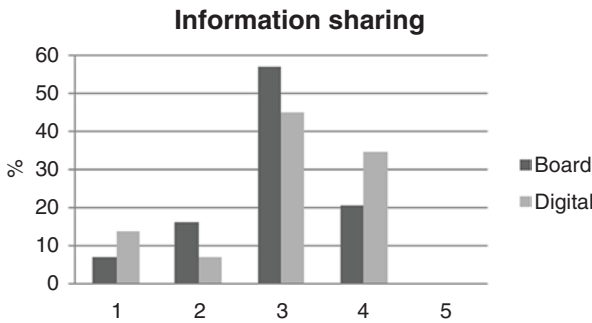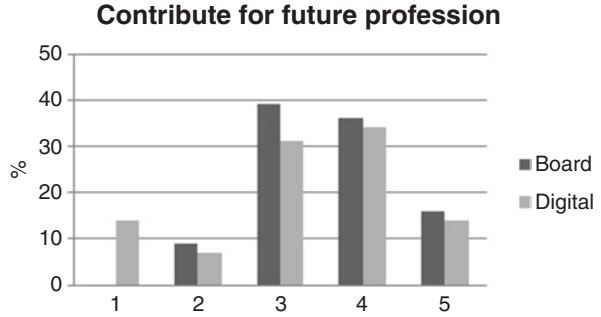
Contribute for future profession

Information sharing

Fig. 5 Comparison between analogue and digital version on the question about relevance of information sharing (1 = not relevant at all, 5 = extremely relevant)

4.2 Information Management and Communication

To understand how well the participants assessed the importance of information sharing and communication for resilient operations, we asked the respondents about their thoughts on the relevance of information sharing for their decision-making during the game play (see Fig. 5).

In the **board game version**, 20% of the participants felt that information sharing was *very relevant*, while 57% felt that it was *relevant*, 16% felt that it was only *slightly relevant*, whereas 7% of the participants did not think that it was relevant at all.

In the **digital game**, 34% of the participants felt that information sharing was *very relevant*, while 45% felt that it was *relevant*, 7% felt that it was only *slightly relevant*, whereas 14% of the participants did not think that it was relevant at all.

4.3   Key Learnings

In addition, we asked the participants to name three key learning points. In both sessions, good communication was mentioned most (15 out of 44 respondents of the analogue game and 12 out of 29 in the digital game). Although mentioned less, in both sessions, the respondents mentioned 'balancing key performance indicators', 'Sometimes takes decisions with negative influence' and 'align strategies and priorities'. The answers also showed some differences. The respondents of the board game session answered that information sharing and selected information sharing are key learning points, while the respondents of the digital game answered that team work and collaboration was one of the key learning points.

4.4   General Remarks

Finally, the respondents had the possibility to add some additional comments about the game and the session. The remarks about the **board game** were that they enjoyed the experiences of the game. Moreover, participants felt that the board game was an interesting, interactive and practical simulation. They said that it was a good exercise to understand the importance of disruption management in transportation and supply chains. They mentioned that the game showed that it was difficult to predetermine a perfect or optimal solution to manage disruptions. However, two participants felt that the game could have been more beneficial to the participants if they had more experience in the port industry. A critical feedback against the game was about its complexity since some participants took longer than others to understand the game mechanics.

The participants of the **digital game** stated that it was an engaging activity. In addition, they mentioned that the game educates them about risk management. One participant remarked that the game was a nice team experience. Other students suggested to play a board game to increase the interaction with team members. One student was entirely unsatisfied with the game.

5   Discussions and Conclusion

The goal of this paper was to compare learning outcomes after playing a digital and a board game with the same topic and learning objective. Having conducted two studies with the disruption management board game and the digital version of it, the results show that they are both good exercises to understand the importance of disruption management in transportation and supply chains.

The learning outcomes of both the digital and analogue version were very similar in terms of students learning about the information sharing and the preparation for

their future profession. However, there was one stark difference in the responses of the students related to the open-ended question on the learning effect of the games. In addition to information management and communication, the participants of the digital game stated that teamwork was very important for effective disruption management. This is a thought-provoking outcome given the quasi-multiplayer nature of the digital game where the social interaction and the perception of teamwork were not tangible since the other players were automated. On the other hand, it shows that the interaction with the non-player characters in the game is a powerful means to represent the value of teamwork and its role for the topic addressed by the games. It is known that if non-player characters are not only visualized in a realistic way, but also behave realistically, they foster the flow and immersion, and thus the learning effect of a game [16].

Another notable difference was observed in the way students enjoyed either game. Participants of the board games seemed to enjoy the game play experience more than the participants of the digital game. This could very well be attributed to a lively social environment of the board game and the lack of social contact in the digital game. In addition, the use of real-world pictures in the digital game increases physical fidelity (the level of realism on which the audio-visual context is represented) therefore more structured and less fun, in comparison to functional and psychological fidelity (the level on which tasks are represented and the level on which emotions like stress and joy are represented) offered by the board game which provided more room for creativity and imagination [17–19]. The result on the fun element of the games was auxiliary and based on observations of the facilitators.

One limitation of the present work is that we did not analyse any cultural influences. This could be a subject of further research. For our learning objective, both digital and nondigital games seemed suitable. Our main conclusion from the study is that the learning effect of a game need not necessarily depend on the type of game (digital or analogue) but rather on the learning principles incorporated or left out in either game.

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