

AN EDUCATIONAL GAME ABOUT SUSTAINABILITY BASED ON ESG+P CONCEPTS

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ABSTRACT

This work presents the design process of a game to teach sustainability concepts. Stakeholder satisfaction analyzes this strategic concept, which considers the organization's investments in Environmental, Social, Governance, and People (ESG+P) resources. Every decision in the game has a risk and implies meeting the stakeholders' interests. This game creates an atmosphere for students to simulate the consequences of their choices without the dangers of the real world.

Keywords: Game Design, Sustainability, Educational Game

INTRODUCTION

This work presents the design process of a game that aims to teach sustainability concepts. Sustainable development and stakeholder satisfaction are strategic concepts that presuppose the sustainability of the resources offered to organizations and the return as rewards and remuneration. Thus, organizations seek the proper use of resources, maximum use, increased efficiency, development of new business models, and rewards in the valences of each resource (BR, 2022).

Decisions on which resources to invest in result in consequences for organizations. In the practice of the so-called Stakeholder Capitalism, these decisions are made considering the effects on the **E**nvironment, **S**ociety, and **G**overnance dimensions (WEF, 2022). The Sustainable Development approach ESGP (Magalhães & Eckschmidt, 2021) incorporates the **P**eople dimension in this analysis.

The game proposed here aims to promote discussion on sustainable development. The game recognizes the effort to find solutions to preserve ESG+P resources (**E**nvironment, **S**ociety, **G**overnance, and **P**eople). It represents an opportunity for students to reflect on the impact of each decision on the stakeholders. As managers must be aware of the risks of their choices and actions, the game allows for simulating organizations' scenarios and challenges.

BACKGROUND

Sustainable development

The difficulty for a precise definition of what sustainability is becoming latent as stakeholders prioritize different paths in their analysis: environmentalists defend the preservation of natural resources, economists look at productivity, sociologists investigate working conditions, etc.

This work uses the concept of sustainability presented by (Magalhães & Eckschmidt, 2021), which defines it as a characteristic of dynamic systems that refer to the preservation and maintenance of the value of non-renewable or manageable resources: environmental, social, organizational, and personal, used over an evolving context to meet the sustainability objectives of the Stakeholders.

The approach adopted for sustainability is the Sustainable Development ESG+P (Magalhães & Eckschmidt, 2021), created by one of the authors – Marcos Felipe Magalhães, which encompasses how quality commitments affect and are affected by the stakeholders. This approach considers attitudes with their long-term effects and the mechanisms organizations have to achieve their ESG+P (Magalhães & Eckschmidt, 2021) objectives.

The introduction of the People perspective is an important innovation, which expands the analysis of the context in the face of current market practice, known as ESG (Environmental, Society, and Governance).

There is an emerging consensus among companies that, in the long term, value is most effectively created by serving the interests of all stakeholders (BR, 2022). The ESG+P proposal allows for a scenario-based analysis of sustainability based on the weighted degree of stakeholder satisfaction. It is considered that to obtain results is often necessary to sacrifice some resources. This trade-off can happen in different amounts or at different moments (Spitzeck et al., 2016).

ESG+P dimension themes can assess and measure the company's performance and relative positioning on a range of topics relevant to the company's broader set of stakeholders in the same way that financial metrics assess company performance for shareholders.

The set of stakeholder expectations is consolidated in the ESG+P Matrix (Magalhães, 2022) (Table 1) that allows the use of ESG metrics, suggested by the Sustainable Development Goals (UN, 2016), Global Report Initiative (GRI, 2022) and World Economic Forum (WEF, 2022). These initiatives guide organizations to adapt in the face of new structures in networks, new partnership models, shared businesses, and value chains that update their relevance daily.

TABLE 1
SUSTAINABLE DEVELOPMENT MATRIX (MAGALHÃES, 2022)

Enviromental		Social		Governance		People	
E1	Ecosystem	S1	Ethics and Values	G1	Value and Purpose	P1	Prosperity, employment, and income
E2	Energy	S2	Human rights	G2	Economic results	P2	Participation and belonging
E3	Climate	S3	Human development	G3	Operating results	P3	Personal development
E4	Sustainable consumption	S4	Economic development	G4	Reputation and recognition	P4	Quality of working life

Educational Games

Games are commonly associated with entertainment or fun. However, more formal definitions of games go beyond this view. Games can be defined as activities between one or more independent decision-makers (players) who seek to achieve their goals in a limited context (Michael & Chen, 2005).

Games teach us to understand the environment, predict the consequences of actions, analyze risks, manage information, calculate probabilities, perform simulations, etc. (Koster, 2013). Educational games are part of the context of serious games and are defined as games whose primary purpose is learning and providing fun (Michael & Chen, 2005). The design of these games reconciles educational goals with playful elements (Bennis & Benhlina, 2015).

The use of games in education is in line with the concept of game-based learning (Breuer & Bente, 2010), which enables active learning and stimulates cognitive abilities, decision-making, problem-solving, competition, collaboration, and student motivation. Thus, educational games make it possible in an immersive, simulated, and risk-free environment to practice decision-making and learn from experience without resulting in the mild or severe consequences that would occur in an actual situation (Jääskä et al., 2021).

Roll and Write and Flip and Write mechanics

Roll and write is a mechanic in which players record their decisions by writing or drawing from the generation of values obtained by rolling the dice. Each previous rolling influences subsequent rollings, possibly limiting what they can write or

draw. Yahtzee (Milton Bradley - Hasbro, 1956) is possibly the best-known game that uses this mechanic. Qwinto (Lach and Rapp, 2015), *Fleet: The Dice Game* (Pinchback and Riddle, 2018), *Chem and roll* (Dietrich, 2019), and Paper Dungeons (Pires, 2020) also use this mechanic.

A variant of *roll and write* is *flip and write*, which, instead of dice results, uses card information to indicate what a player can mark on their sheet. Cards can present more information to players compared to the dice' faces. Cartographers (Adan, 2019), *Welcome To...* (Turpin, 2018) and Hadrian's Wall (Hill, 2021) are games that contain this mechanic.

Games based on these mechanics can be designed to require little or no interaction between players and allow all players to make decisions simultaneously. In addition, these games use little material and are easy to produce as players print out the worksheets and cards, *roll* dice, *flip* cards to get results, and use a pencil or pen to *write* features. So, these games ensure flexibility in the number of players and make it easier to play in classrooms.

RELATED WORKS

The related works comprise games that involve strategic management, resource management, and sustainable development. The mechanics of these games include rolling dice, writing the results, and choosing actions. Games about sustainability usually focus on the environmental dimension, but we also find games with social and governance dimensions.

Ferman and colleagues (2015) created an educational board game where small teams of players play the role of managers of software development companies. The central dynamic is balancing the size and productivity of the development team and the company. Players should consider the portfolio of current and future projects and clients. The mechanics include hiring and training employees, bidding for contracts, and defining the company's physical space to allocate employees. At the end of each turn, any player rolls the dice, and the results set the market state for the next turn, which affects all players. On each turn, players draw action cards and choose one to define their action.

Nunes and Xexéo (2015) created an educational card game that simulates a space exploration scenario to teach the dynamics of new markets, including market saturation, complementary markets, and entry barriers. Silva and Xexéo (2017) also created a card game to teach the mechanics of a stock market and investments. Game dynamics guide players to balance and diversify their portfolios with low and high-risk investments to optimize their profits. These two works emphasize the importance of debriefing to discuss the lessons learned. Both games present event cards to all players to choose their actions. Dice rolling provides randomness to these games and influences player actions.

Kaneko and colleagues (2021) developed an analog game to teach business management. The challenge of the game design was to adopt procedures to conduct it online during the restrictions caused by the coronavirus pandemic. The mediator coordinated the game using a camera and a blackboard, on which he fixed the worksheets of the companies and the markets. This game has no cards to guide the players' actions. In each turn, students choose in which market they would distribute their product against competitors, define the selling price, and decide the quantity of the product they will manufacture to be available for sale in the next turn. The mediator placed the products on the worksheets for each market and wrote down each player's results, including the number of products sold in each round based on the lowest price in each market and the number of products manufactured.

Sustainability was the theme of digital strategy and simulation games. Jesus and colleagues (2021) focused on environmental education, where students carry out actions and strategies to make society economically and ecologically viable. Through the management of financial and environmental resources. Players must eliminate the emission of polluting gasses, plant

trees, and promote sustainable companies and research centers. The game even generates random environmental events, such as fire, that can increase pollution rates. Baumgartner and Winter (2014) managed environmental, social, and economic resources over time. Indicators measure the consequences of decisions and actions. Players decide product prices, the number of cars produced in a period, purchasing raw materials, and hiring employees. At the end of each round, the game engine will calculate the results and update the indicators. In addition, sudden events can affect management decisions, such as supplier companies' strikes, a breakdown of production equipment, or intensified environmental controls by authorities. Jääskä and colleagues (2021) applied sustainability concepts in the decision-making process in project management. Players must plan and prepare for coming tasks to ensure that resources, materials, and personnel are available. Uncertainty is present throughout the game: employees may not complete a job on time, the manager has not adequately estimated a task, customers have changed some requirements, and other elements external to the project, such as weather conditions. Our educational game contemplates the Person dimension and thus expands the pillars of sustainable development: environmental sustainability, social responsibility, conscious governance, and humanism at work.

RESEARCH METHOD

The design process of the ESG+P game used the method LUDES – *Games Development* (Mangeli et al., 2022), created for the development of serious games and has five stages: Conception, Project, Development, Evaluation, and Packaging.

The game design included defining its purpose, target audience, and educational objectives and elaborating on its preliminary description. In the project stage, the documentation began, and the mechanics, rules, and other components were defined. The development comprised building analog and digital prototypes to simulate the game.

The authors and other laboratory members evaluated the game with simulated gameplays. The matches pointed out opportunities for improvement, so after each one, we returned to the design phase to review some design decisions. We did not collect pre and post-data on these gameplays to measure players' learning about sustainability concepts. However, we will measure learning through questionnaires when we play the game in classrooms of business courses.

RESULTS

Conception

The sustainability theme is present in science, technology, engineering, and mathematics courses. The basic idea was to create a business game that combined the mechanics of *roll and write* and *flip and write*, whose educational purpose would be to teach sustainability in the classroom to students of disciplines on strategy, management, and operations. Thus, at the project stage, the authors learned about issues related to sustainable development and its goals, stakeholders, and ESG+P production resources.

The game design considered game conditions for the classroom: up to 60 participants; duration between 45 minutes and one hour; turn duration control (between 5 and 10 minutes); deal with a specific case; there are no direct attacks between players (each player's decisions do not affect the others); uncertainty should not change the relationship between players; random events must be presented simultaneously to everyone; the initial turn should guide the initial actions of the game; and the difficulty presented must evolve considering the proximal development (Vygotsky & Cole, 1978) (Dias et al., 2016).

We considered some constraints of business games: the initial decisions impact the final situation; the game must be immune to the End Game Effect (Engelstein & Shalev, 2022), that is, the game does not allow the player to take an unreasonable action, such as investing all of their resources in something that pays off quickly in the last turn; and a debriefing must be carried out to analyze the players' decisions.

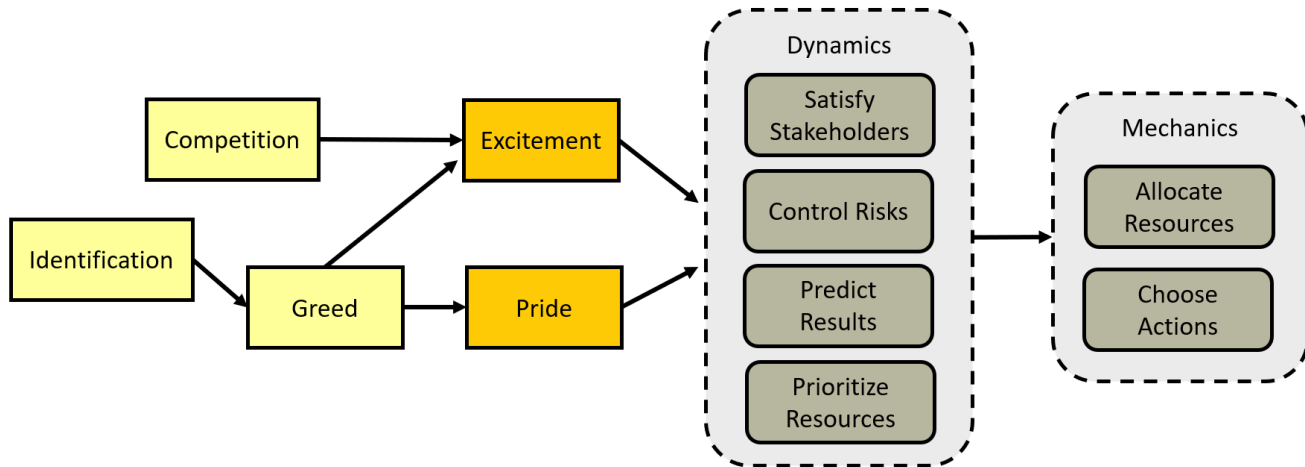
Finally, we considered specific conditions for the ESG+P game: the game is individual; there is no relationship between player actions; and the players' results can be compared by adding their valences at the end of the game, except for the scores of unsatisfied stakeholders.

Project

The game design used the concepts of the MDA, which stands for Mechanics, Dynamics, and Aesthetics (Hunicke et al., 2004), and the 6-11 framework (Dillon, 2011). Thus, we constructed a diagram (Figure 1) to represent the relationships between game mechanics, dynamics, and the aesthetics (emotions and instincts) stimulated in players. Self-identification instinct arises in the players since the students will learn through the game to occupy functions of company managers who make decisions considering the ESG+P dimensions. Competition and greed are evoked because the players aim to expand the company's market share in a competitive scenario and satisfy different stakeholders. Although the decisions consider the ESG+P dimensions, the shareholders aim to increase their profits. These instincts can trigger excitement and pride in players when their decisions result in higher ESG+P indicators than their competitors. The game has two basic mechanics. Players must allocate resources to invest in ESG+P dimensions and choose actions that result in earning or spending resources in ESG+P dimensions. These mechanics unfold in the game dynamics, which awaken those instincts and emotions in players. Game dynamics include prioritizing the resources that will be invested, controlling the risks of not investing in certain resources, predicting the results of their decisions, and achieving resource scores to satisfy stakeholders.

The game was designed to be scalable concerning the number of players since it is proposed to be played in the classroom in management courses with many students. Thus, it would be feasible for 60 players to participate in the same game, for example. There is still the figure of the mediator who controls the execution of the game and analyzes the actions of the players. He would commonly be represented by the professor responsible for the course.

FIGURE 1
DIAGRAM 6-11 OF THE SUSTAINABILITY GAME



At the beginning of the game, each player must choose a branch of the company, which conditions the definition of four stakeholders in its sustainable development. Each stakeholder represents an objective that the company aspires to. The game has five turns. Players must decide which ESG+P resources will be invested at each turn to serve stakeholders and achieve company goals.

The objectives are prioritized, and each one has a minimum score according to its priority: 70, 80, 90, and 100. A weighted sum of the invested resources obtains the score for each objective. So, a weight is assigned to each feature in this calculation. The sum of the resource weights must be five. A resource may not influence the objective score, so its weight in this calculation is null.

Each player starts the game with 10 points invested in each of the four resources. Thus, the stakeholders of each company initially have 50 points. Figure 2 illustrates a company's resource sheet, which contains the company's identification, a field for the student to fill in their name, four worksheets to score the ESG+P resources invested in each step of each round, a frame to write down the Action card - and occasionally the Event card - and the option that was chosen on the card in each round, a chart to graphically record the number of resources that the company has in each round, and the four stakeholders that must be satisfied. Each stakeholder is characterized by the weight of each resource and the minimum score that must be achieved to satisfy it.

Each turn contains two or three steps. The *Investment* and *Action* steps are present in all turns. The *Risk* step occurs in the third and fifth turns.

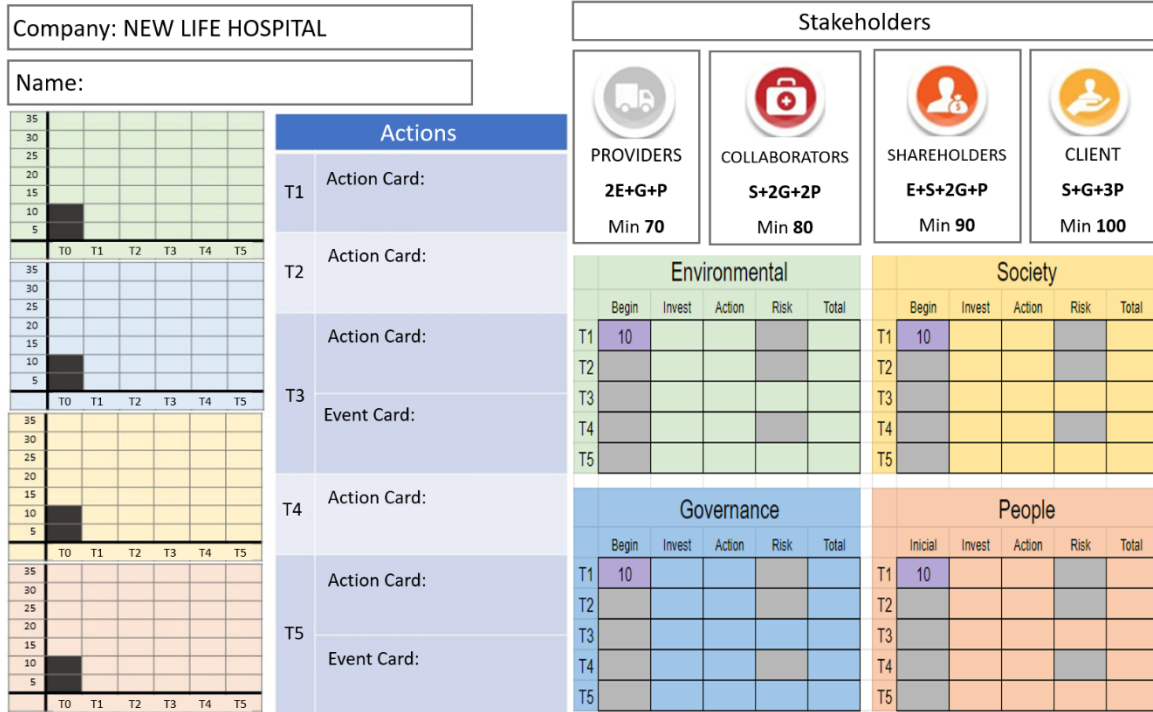
In the first step, Investment, the dealer rolls four six-sided dice, one for each resource. Each player chooses two dice and two resources. Therefore, the result of a die corresponds to the amount invested in a resource. Finally, the player writes down the values on their resource sheets, specifically in the *Investment* column of the row for that turn. The other two data will be ignored.

In the next step, Action, the mediator presents four cards drawn from the top of the Action Card pile. Each card presents a situation referring to a quadrant of the ESG+P Matrix, which reflects on the company's investment. Each card has two attitude options that allow the player to add a resource, but this investment can also cost another resource.

The gain and cost of each option are on the back of the card. Thus, they are not visible. Hiding this information encourages players to make decisions based on their knowledge and convictions and not on the values of winnings and costs. Each player chooses the card that best meets their company's goals or prevents resource depletion. In this way, they record the amount invested in the resource sheet, specifically in the *Action* column of the row for that turn, and eventually subtract the cost of the other resource in the *Action* column of the same row.

In the third step, risks are incurred from events contained in Event cards, which are applied to all players. Risk is usually associated with a negative effect on achieving a goal. Still, modern theory indicates that risk can also produce a positive impact (PMI, 2014) when it is synonymous with opportunity. In this game, the risks are equally distributed on the company's

FIGURE 2
COMPANY RESOURCE SHEET



resources in positive or negative events. The player must write down (subtract) the resource affected by the risk in the *Risk* column of the row for that turn. In the case of positive risks, players add resources.

An Event Card still allows players to react to risk; for this, the player must meet a condition that considers the number of resources already invested. Thus, a positive risk can be significant for the company if the resource in question meets one state. A negative risk can harm the company if the resource does not satisfy another condition.

The presence of the risk step in the odd turns helps to avoid the End Game Effect (Engelstein & Shalev, 2022), where players could optimally reinvest their resources, knowing that the game will be over.

The game ends after finishing the fifth turn. The players who win the game meet the following conditions: a) Achieve the minimum score for each stakeholder, which is calculated by weighted sums of the resources invested by the players during the game. b) Do not exhaust any of the four E-S-G-P production resources.

Development

First, we simulated the mechanics and dynamics of the game using a spreadsheet in Google Sheets, which registered companies from different industries, stakeholders, Action cards, and Event descriptions. The spreadsheet’s tabs represented each player’s resource sheet. The tabs contained the tables and charts to score the features and objectives to meet the stakeholders. We defined the weights of resources in each objective. Four random numbers were generated to simulate the investment step. Players chose the cards they would use in the Action and Risks step. The resource gain and cost values were visible but will be hidden in the following artifacts to simulate the game.

Next, we built the board game prototype that has the following components: 36 company score sheets, 64 Action cards, 8 Event cards, and four six-sided dice. Score sheets delimit the four stakeholders of the companies, the places to place the pile of Action cards (Strengths and Weaknesses) and the pile of Event cards (Opportunities and Threats), and the worksheets for players to score the four resources.

Evaluation

We conducted online, and in-person playtests in the laboratory with four participants. The initial evaluations were largely positive. Players praised the game's dynamics and suggested new mechanics be included in the design, for example, the possibility of Events cards producing a positive effect that allows players to add resources. In addition, we noticed that the game balance during the game's steps could still be better adjusted, such as the weights of resources in objectives and possible gain and cost values of resources. We decided to use *Machinations* (Adams & Dormans, 2012), a tool that helped us balance the game's internal economy (Schreiber & Romero, 2022).

Although the game design was already in an advanced stage, there was still room for improvement, and the feedback from the participants was crucial for this. The suggestions for new mechanics were helpful and will bring players more fun and challenging experiences. Adjusting the balance of resources was also essential to ensure that the game was fair and exciting at the same time. We don't want players to feel frustrated because they don't have access to enough resources or, on the other hand, have everything handed to them on a silver platter. The right balance is essential to provide a pleasant gaming experience. We are excited to continue working on the game design and hope it will be successful when it is finally released.

Packaging

We designed the company resources sheets (Figure 2) and the Action and Event cards. This digital material is available for download at the following address: <https://ludes.cos.ufrj.br>.

When students play the game in the classroom, this material must be printed for players to record ESG+P resources invested, earned, and consumed; and assemble the two piles to remove the cards in the Action and Event steps. In addition, you need to arrange four six-sided dice that will be used in the Investments steps.

DISCUSSION

During the game design, an author warned that Action cards contain some options that players are unlikely to choose. Thus, the authors questioned whether keeping options that players would not choose would be valid. The authors discussed this subject and concluded that it would be reasonable because it represents a way of teaching that these would not be good attitudes to be adopted in companies.

Another author observed that most of the costs resulting from the options (attitudes) of Action Letters involved Governance, which reflects what commonly occurs in companies in the real world. So, he questioned whether it would be a problem for the game to be unbalanced, despite efforts to create a balanced and fun game.

In most games, the out-of-balance can result in a design issue, and it is necessary to review the positive and negative feedback resulting from the game mechanics. However, it would be no problem for an educational game to be unbalanced as long as it can transmit its educational goals. In addition, actual situations are usually unbalanced. The game must reflect reality and allow players to learn even when they don't win.

The authors also thought of a way to stimulate discussion in the game. They suggested that each company could have four members representing different stakeholders to decide which resources to invest in. Thus, the ESG+P game could have two modes: individual or in teams.

Finally, the possibility of the company gaining long-term resources through Action cards is still considered. Thus, the gain of a given card could be applied in more than one turn.

CONCLUSION

This article presented the design process of a game to teach sustainability. The game goal is to exercise decision-making considering the investment in ESG+P production resources and stakeholders' satisfaction.

The game uses the *roll and write* and *flip and write* mechanics. The first allows players' actions to have consequences in the game and facilitates the application of the game in the classroom, while the second adds information that influences the game through Action and Event cards.

The game evaluation was limited to some games that the authors played. Although they have contributed to adjusting it, the game still needs to be applied in strategic management disciplines to obtain the students' opinions. So, they want to check if the game meets their educational objectives. After this evaluation, the packaging step could be carried out to complete the game's design process.

We should have collected pre and post-data on the first gameplays to quantify how much players learned sustainability concepts. We recognize that this measure enhances the rigor of game design research. In addition, this measure would help the authors to propose new mechanics to the game to stimulate learning about sustainability. However, we intend to measure students' learning through questionnaires when we play the game in classrooms of business courses.

For future works, we plan to implement a digital version of the game, which would store the actions and results of the gameplay. Thus, instructors would have a database always available to analyze players' decisions and obtain the lessons learned.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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