International Journal of Innovation

e-ISSN: 2318-9975
https://doi.org/10.5585/2023.24267
Received: 13 Apr. 2023 - **Approved:** 14 Oct. 2023

Evaluation Process: Double Blind Review
Editor in Chief: Priscila Rezende da Costa
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CREATING A GAME PROTOTYPE FOR TEACHING ADMINISTRATION

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Cite as – American Psychological Association (APA)

Oliveira, P. H. P., Ssaki, D. G. G., & Miyashita, R. (2023, Mayo/Aug.). Creating a game prototype for teaching administration. *International Journal of Innovation - IJI*, São Paulo, *11*(2), 1-36, e24267. https://doi.org/10.5585/2023.24267

Abstract

Objective: describe the process of idealizing and creating the prototype of a new business game that stimulates spontaneous learning, since as there are no decision rounds, students will only make decisions when they recognize the need for their intervention.
Methodology/approach: In a qualitative approach, the methodological course of this research begins with the mapping of the pedagogical needs of the discipline in which this type of game is used, followed by the creation of the game model through the Business Game Canvas method, and finally the implementation of the game with its components and rules, up to preliminary testing of the prototype. To assess the students' perception of the experience with the game, a questionnaire already statistically validated in its original publication is used.
Originality/value: In the context of higher education in Brazil, in which MEC (Ministry of Education) suggests that universities increasingly seek ways to integrate theoretical content with practice, active teaching-learning methodologies offer students a greater role in their educational process. Aligned with this purpose, offering students an experience that privileges their independence from the results of one team in relation to the others means stimulating spontaneous learning and allowing all stages of the experiential cycle to take place during the class.
Main results: The results obtained from university students, volunteers from the administration course, reveal that the new game obtained a score above 6 in Clarity, Challenge, Attitude and Perceived Learning while it needs to improve in the dimensions of "intention to continue playing" (average score of 5) and Autonomy (average score of 4.8).
Theoretical/methodological contributions: The main contribution of this research is to present a business game prototype that is complete, operational and well evaluated by the students. In this way, the benefits of a game without rounds of decisions can be explored in new research.
Social/managerial contributions: The use of active teaching methodologies contributes to making society more responsible for its learning – with this type of game, it is believed that teachers will be able to train administrators who are more prepared for the challenges of the job market.

Keywords: business game; design science research; double diamond; business game canvas.

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A CRIAÇÃO DE UM PROTÓTIPO DE JOGO PARA O ENSINO DA ADMINISTRAÇÃO

Resumo

Objetivo: descrever o processo de idealização e criação do protótipo de um novo jogo de empresas que estimule a aprendizagem espontânea, uma vez que por não ter rodadas de decisões os alunos tomarão decisões apenas quando reconhecerem a necessidade de sua intervenção.
Metodologia/abordagem: Em uma abordagem qualitativa, o percurso metodológico desta pesquisa começa no mapeamento das necessidades pedagógicas da disciplina em que este tipo de jogo é utilizado, seguindo para a criação do modelo do jogo através do método Business Game Canvas, e por fim a implementação do jogo com seus componentes e regras, até os testes preliminares do protótipo. Para avaliar a percepção dos alunos sobre a experiência com o jogo, utiliza-se um questionário já validado estatisticamente em sua publicação original.
Originalidade/valor: No contexto da educação superior no Brasil, onde o MEC sugere que cada vez mais as universidades busquem meios de integrar os conteúdos teóricos com a prática, as metodologias ativas de ensino-aprendizagem oferecem ao aluno maior protagonismo em seu processo educacional. Alinhado a este propósito, oferecer aos alunos uma experiência que privilegia sua independência dos resultados de uma equipe em relação às outras, significa estimular a aprendizagem espontânea e permitir que todas as etapas do ciclo vivencial aconteçam durante a aula.
Principais resultados: Os resultados obtidos com alunos universitários, voluntários do curso de administração, revelam que o novo jogo obteve nota acima de 6 em Clareza, Desafio, Atitude, e Aprendizagem percebida, e precisa melhorar nas dimensões de "intenção de continuar jogando" (nota 5) e Autonomia (nota 4,8).
Contribuições teóricas/metodológicas: A principal contribuição da pesquisa é apresentar um protótipo de jogo de empresas pronto, operacional e bem avaliado pelos alunos. Desta forma, permite-se que seja explorado em novas pesquisas os benefícios de um jogo sem rodadas de decisões.
Contribuições sociais/gerenciais: O uso das metodologias ativas de ensino contribui para que a sociedade seja mais protagonista de seu aprendizado, e com este tipo de jogo acredita-se que os professores poderão formar administradores mais preparados para os desafios do mercado de trabalho.

Palavras-chave: jogos de empresa; design science research; business game canvas.

CREANDO UN PROTOTIPO DE JUEGO PARA LA ENSEÑANZA DE LA ADMINISTRACIÓN.

Resumen

Objetivo: describir el proceso de idealización y creación del prototipo de un nuevo juego empresarial que estimule el aprendizaje espontáneo, ya que al no existir rondas de decisión, los estudiantes solo tomarán decisiones cuando reconozcan la necesidad de su intervención.
Metodología/enfoque: En un enfoque cualitativo, el recorrido metodológico de esta investigación se inicia con el mapeo de las necesidades pedagógicas de la disciplina en la que se utiliza este tipo de juego, seguido de la creación del modelo de juego a través del método Business Game Canvas, y finalmente la implementación del juego con sus componentes y reglas, hasta la prueba preliminar del prototipo. Para evaluar la percepción de los alumnos sobre la experiencia con el juego se utiliza un cuestionario ya validado estadísticamente en su publicación original.
Originalidad/valor: En el contexto de la educación superior en Brasil, donde el MEC sugiere que las universidades busquen cada vez más formas de integrar el contenido teórico con la práctica, las metodologías activas de enseñanza-aprendizaje ofrecen a los estudiantes un mayor protagonismo en su proceso educativo. En línea con este propósito, ofrecer a los estudiantes una experiencia que privilegie su independencia de los resultados de un equipo en relación con los demás, significa estimular el aprendizaje espontáneo y permitir que todas las etapas del ciclo experiencial se desarrollen durante la clase.
Principales resultados: Los resultados obtenidos con estudiantes universitarios, voluntarios del curso de administración, revelan que el nuevo juego obtuvo una puntuación superior a 6 en Claridad, Desafío, Actitud y Aprendizaje Percibido, y necesita mejorar en las dimensiones de "intención de seguir jugando". " (grado 5) y Autonomía (grado 4.8).
Aportes teóricos/metodológicos: El principal aporte de la investigación es presentar un prototipo de juego de negocios listo, operativo y bien evaluado por los estudiantes. De esta forma, los beneficios de un juego sin rondas de decisiones pueden explorarse en nuevas investigaciones.
Aportes sociales/gerenciales: El uso de metodologías activas de enseñanza contribuye a que la sociedad sea más protagónica de su aprendizaje, y con este tipo de juegos se cree que los docentes podrán formar administradores más preparados para los desafíos del mercado laboral.

Palabras clave: juegos de negocios; investigación en ciencias del diseño; lienzo de juego de negocios.

1 Introduction

Professors who teach undergraduate and postgraduate courses in Management and Business are always looking for new ways to associate theory with market practice (OLIVEIRA and SASAKI, 2022). The Ministry of Education recommends in the Curricular Guidelines for Administration Courses that educational institutions encourage activities that integrate theory and practice in their context of application (BRASIL, 2021).

In order to follow this recommendation, each teacher should employ a set of methodologies that provide both content learning and the development of skills that are relevant to the students' academic and professional training. In particular, one didactic resource that is common in these courses is the use of business games as an element that brings students closer to the real experience of the corporate environment (Schmitt et al, 2021).

Biggs (1990) stated that there are various ways of categorizing games, whether they are total or functional, competitive or collaborative, interactive or non-interactive, individual or team games. Alves (2015), on the other hand, presents a different segmentation, classifying games by their archetypes: war games, role-playing games (RPG) and business games.

A relevant point to highlight is that there are basically two kinds of academic publications about the use of business games in teaching. In the first, the subject of games in general is the object of research that is being analyzed in some way. Examples of this first type include Teach and Murff (2008), who analyzed different degrees of complexity in games; Aragão (2009), who checked the effects of games on student learning; and Oliveira (2018), who sought to understand the relationship between teams in the learning process. The other line of research on business games is on the use of these simulators as management laboratories, with a focus on training and developing specific concepts, which can be about logistics, marketing, finance, capital markets, etc (Ribeiro et al 2015).

The most widely used format of these business games is the one in which rounds of decisions are used (PRETTO, 2007). In other words, in each round the students have a set amount of time to make their decisions until all the teams are ready to proceed to the next round. From an educational point of view, these rounds can prevent students from having the real experiential learning that the business games method is intended for, because if the student makes decisions without thinking to meet the deadline, they will not achieve the educational objective of understanding the need to take such action. (PRETTO, 2007) An alternative that

does not have this characteristic is RPG games, although they present a certain complexity to be applied to the context of teaching management. (OLIVEIRA, 2018)

Considering that in a company game with rounds students can only advance to the next one when everyone is ready to move on, the general objective of this research was to create a new game structured in such a way that the student's progress does not depend on the other participants, and thus to allow each one to progress at their own pace and make decisions only when they feel the need to intervene.

The game prototype was developed using Design Science Research (DSR) methods structured on the basis of the Protocol for Preparing Technical Production Reports (Biancolino et al, 2012). In the following sections, the context in which this prototype was developed is presented, followed by details of the intervention carried out, the methods used and the results obtained.

2 Literature review

2.1 Business Game

The first records of business games according to Mrtvi et al (2017) credit the Top Management Decision Simulation game as the first created in the United States in 1956. Brazilian educational institutions started working with this type of game only in the 1970s (SAUAIA, 2009). Since then, various scholars have continued to research the subject and develop new games, but the advance of technology has certainly boosted publications on teaching based on this type of game even more since the year 2000 (BERNARD, 2006, PAIXÃO, BRUNI and CARVALHO, 2015). It is worth noting that there are other types of games applied at different educational levels, which are not classified as business games.

It is common to find different views on the benefits of game-based teaching (not just business games), and this is not an inconsistency. Such divergence of opinion is caused by the numerous types of systems that exist, providing different pedagogical approaches and experiences. In the highlighted excerpt below, the authors present their objectives for using this game-based teaching method. Note that these are not mutually exclusive perceptions, but it is clear that each researcher is directing their research towards a different focus.

> According to Bellotti, Kapralos, Lee, Moreno-Ger and Berta (2013) and Tan, Tse and Chung (2010), learning through games has four main objectives: to make knowledge more accessible, to make thinking visible, to make learning fun and to promote autonomous learning. For Sauaia (2010), the objectives of business games, particularly for undergraduates, include the imposition of a systemic view of organizations, the insertion of economic issues and the development of critical thinking in decision-making. (Torga et al., 2018, p. 302)

In this regard, it is possible to find academic publications with empirical tests on games of different genres (BERTAZZO et al, 2018, APESTEGUIA, AZMAT and IRIBERRI, 2012), different cognitive styles (OLIVEIRA and MELO, 2020) and even different levels of simulator complexity (TEACH and MURFF, 2008).

In order to build the prototype of a game with an innovative proposal, which in this case is the fact that it has no decision rounds, it is important to understand the essence of what a game is so that the artifact can be designed correctly. Salen and Zimmerman (2012) presented 15 authors defining what games are. It was noted that each author conceptualized it differently, so it was not possible to reach a common point. Table 1 compares the elements used by the various authors studied.

Quadro 1

Comparativo de elementos da definição do conceito de jogo

Elements of a game definition	**Parlett**	**Abt**	**Hulzinga**	**Caillois**	**Suits**	**Crawford**	**Costikyan**	**Avedon and Sutton-Smith**
Proceed according to rules that limit the player	√	√	√	√	√	√		√
Conflict or competition	√					√		√
Goal-oriented / result-oriented	√	√			√		√	√
Activity, process or event		√			√			√
Involve decision-making		√				√	√	
Not serious and absorbing			√					
Never associated with material gain			√	√				
Artificial / safe / out of the ordinary			√	√		√		
Create special social groups			√	√				
Volunteer				√	√			√
Uncertain				√				
Make believe / Representational				√		√		
Inefficient					√			
System of parts / resources and tokens						√	√	
An art form							√	

Source: Salen e Zimmerman (2012).

Based on this study, it is possible to synthesize a definition of what a game is by combining the various characteristics mentioned. However, considering that when including a game of this type as a curricular component of an undergraduate course the professor has certainly validated the seriousness and efficiency of the simulator, the elements "not serious and absorbing" and "inefficient" can then be eliminated; and the element "voluntary" is ignored since the game is mandatory when applied in undergraduate courses (SALEN AND ZIMMERMAN, 2012).

Combining some of the aforementioned elements, it is possible to identify a way of defining a business game: a system of parts that proceeds according to rules that limit the player, who manages a company in an artificial and representational way, oriented towards objectives

with activities and events that involve decision-making, without material gain, but which can generate competition and the creation of special groups.

2.2 Game Design

Adams and Rollings (2006) propose that the development of a game should be centered on the player, in other words, the designer should put themselves in the place of the user/player in order to create something that is enjoyable and fulfills its purpose.

De Sousa and Mendes (2020) present some definitions of design and suggest a general way of defining it: "Design is the process through which the designer creates a context to be met by a participant, from which meaning emerges". These authors go on to explain each element of the definition: the designer does not need to be trained in the field, but is the one who is dedicated to creating the game; the context can take different forms according to the game being created, and can be either the physical space, the objects, the narrative and even the behavior; the participants are naturally those who will experience the game, explore its environment and manipulate its variables; and the meaning is the objective to which the actions of the playing participants are directed during the course of the game.

Luban (2001) suggests that the process of creating a game follows four stages: defining and organizing the objectives, defining the main parameters of the game, filtering the results and validating whether the objective has been achieved.

3 Methodological Procedures

This section presents the stages of creating a prototype of a new game. A game can be considered an artifact, so its development can be framed within the Design Science Research (DSR).

Biacolino et al (2012) suggested a Protocol for the Preparation of Technical Production Reports, which was adopted in this document to make it easier to understand the whole process of designing and developing the prototype. According to the aforementioned authors, it is necessary to start by presenting the Context, so that the Intervention proposed to solve the problem can then be detailed. The following table 1 describes how the problem was solved and the results obtained.

Table 1

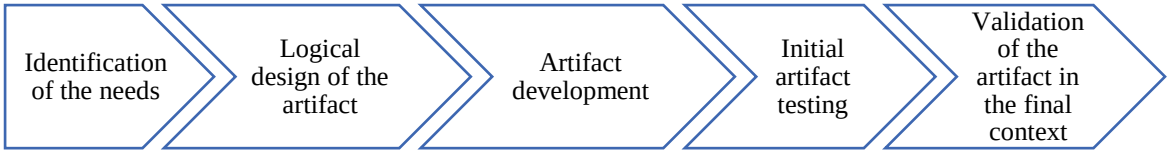
Application of the PERPT to research

Technical Production Reporting Protocol	Application in this prototype
Context	Teaching management through Business Games
Intervention	Prototype without decision-making rounds
Methods used	DSR – Design Science Research Brainstorming BGC – Business Game Canvas (evaluation) Survey
Results obtained	Clarity: 6.6 Challenge: 6.1 Autonomy: 4.8 Attitude: 6.8 Intention to continue playing: 5.0 Perceived learning: 6.3

Source: Own elaboration.

De Sordi, Azevedo and Meireles (2015) presented a flow that illustrates in a very didactic way the steps that DSR uses to create an artifact. Figure 1 represents an adaptation of the original flow, summarizing the process from identifying the need up to validating the artifact. The main highlight is that there are two different tests in the process: the first one is done by subject matter experts to check that the prototype is working properly, while the second is the application of the prototype in a context similar to the one in which the game is intended to be used, in order to validate that it meets the previously defined objectives.

Figure 1 *Research phases according to Design Science*



Source: Adapted from De Sordi, Azevedo and Meireles(2015)

Regarding the DSR methodology, the second stage of the process is the logical conception of the artifact. To achieve this, the brainstorming technique was used. The creator of this technique defines brainstorming as follows:

> "It is ideation - the part of the process that requires imagining all possible conjectural ideas as solutions or directives to other ideas that may in turn lead to the solution... The more ideas we conceive conjecturally, by means of alternating possibilities, the more likely we are to hit upon one or more that will solve the problem." (OSBORN 1987, p.129)

Bonnardel and Didier (2020) present a more operational breakdown of how classic brainstorming can be applied. The first stage, called "Orientation", happens when the research coordinator gathers a working team to present the problem to be analyzed and a briefing on the group's upcoming tasks. The second stage, "Preparation", is the moment when team members have time to freely present any ideas about the problem initially shown, and all ideas must be noted down by the coordinator.

The next stage is called "Analysis", in which the whole team analyzes each of the ideas to group them in a way that is coherent with the research, for example, separating ideas about the content to be covered in a different group from ideas about the mechanics of the game, or about the objectives and duration of the game.

The fourth stage of the process suggested by Bonnardel and Didier (2020) is called "Ideation", in which the team begins a process of refining the ideas presented in order to choose those that will be most relevant to the creative process to solve the specific situation being analyzed. In some cases, the author suggests an optional stage called "incubation", which happens when the group's performance is not satisfactory, and so it is recommended to interrupt the activities to return with new data at another time.

The final phase, called "synthesis and evaluation", consists of closing the activity itself, led by the coordinator, but with the participation of the whole team, to detail the solution found by the group to the problem initially presented, comparing it with the briefing to check that everything is in agreement.

Another useful tool for the game design phase is the Business Game Canvas (BGC) created by Andrade and Miyashita (2019). It is an adaptation of the Canvas often used in the field of management to analyze the essential resources for the success of a business (OSTERWALDER and PIGNEUR, 2011). The BGC is used in conjunction with brainstorming

and, for this reason, it is recommended that two versions of the model be drawn up: the first one with all the ideas, and the second with the closing of the brainstorming, selecting the most relevant information to the project (ANDRADE and MIYASHITA, 2019).

4 Methodological framework of the research

Based on the method presented by De Sordi, Azevedo and Meireles (2015) for the creation of an artifact, this research is classified as a descriptive experiment on the development of the prototype of a business game. In terms of approach, this research is qualitative in nature as it is "a process of reflection on methods and techniques for a detailed understanding of the object of study in its historical context and/or according to its structuring" (OLIVEIRA, 2005).

Furthermore, considering Rosa and Delabrida (2021), this research also has the characteristics of an experiment, describing the practical application of DSR concepts in the creation and validation of the prototype. It is worth noting that this study does not aim to obtain definitive results, but rather to expand new possibilities for the field of games research.

5 The artifact development process

Considering the entire context that has been hitherto presented, it can be summarized that the development of this prototype aims at giving students a greater role in Business Games classes, thus fitting in with a new contribution to the academic literature on the subject, opening up new opportunities in the teaching and learning process.

5.1 Identifying the parameters needed for the prototype

This research began in the second half of 2019, when a meeting was held with three game studies professors at UERJ's production engineering department. The meeting lasted about 3 hours, starting with an initial presentation of the central idea, going through some questions from the UERJ professors followed by a brainstorm in order to come up with the first guidelines for creating the prototype. In the end, some basic definitions were reached, which are described below:

- Some criticisms were raised regarding the format of games with decision rounds, and RPG games were mentioned as possible references for building a round-less business

game. Attention must be paid to the necessary adaptations for classroom use, as most RPG games involve direct clashes between characters. To avoid conflicts and undesirable situations in the classroom, the group determined that the game character should be the company managed by the students, so that all confrontations that occur in the game will be analogous to market competition;

- The game length should be planned to fit within the timeframe of a weekly class, approximately 2 hours, with a total sequence that aligns with the academic calendar of one semester;
- Still considering the game time, for the purpose of creating a reference that can replace the decision rounds, the idea of using a real-time based game emerged. In other words, the proposal is for the simulation time to be linked to a clock that considers a mathematical calculation to be defined later. For example, during class, every 30 minutes in the real world would correspond to 30 days passing in the game;
- From a technical standpoint, considering the limitations of knowledge and time, the group decided that the prototype would be developed without using more complex programming languages in order to keep the focus on the research. An initial prototype could be produced using Microsoft Excel, while more technologically advanced features could be planned for future versions.
- Bearing in mind the limitations of the prototype, even though the game was designed to promote interaction among students in the class, this level of interaction would require programming skills for the software, which would deviate from the research focus. Therefore, the group concluded that the prototype would be developed for individual use by students, leaving the possibility of integration for future phases of the game development.
- Considering the narrative of RPG games, the team considered it appropriate to create an immersive and information-rich environment to promote greater engagement among students. The choice was to create a fictional country with a map and a completely disconnected political, economic, and social context from the real world, so that students wouldn't bring any pre-existing knowledge into the game.
- In order to ensure the application of the concepts learned in the business administration course, the chosen business scenario for the game development was focused on the experience of starting a business within the agribusiness sector. This allows for the creation of scenarios involving industries and retail stores in future stages of the game

development, with the objective of simulating supply chain relationships within the classroom.

After the meeting with the development team, the guidelines obtained were integrated with the other research definitions to add more robustness to the planning of the game prototype. The next step was to structure all the information gathered so far to begin the conception of the prototype. The chosen tool for this stage was the Business Game Canvas (BGC).

5.2 Logical Design of the Artifact

The development team conducted a brainstorming session on the possibilities of the artifact development, specifically the game, based on the guidelines and premises defined in the previous stage. A Business Game Canvas (BGC) was created to organize the information and assist in monitoring the development of the game prototype. Table 2 can be considered the first version, also referred to as Business Game Canvas 1 (BGC1). It contains a broad range of possibilities for developing the game in the future. It is important to note that not all the features mentioned in BGC1 will necessarily be incorporated into the game.

The decision of which elements would be included or excluded from the game prototype was postponed to a later stage. The BGC1 was created following the format originally proposed by the authors, with a possible adaptation in a later version to accommodate the specific requirements of the present artifact.

Frame 2

Business Game Canvas 1 applied to the game prototype, featuring various development possibilities

Guidelines	Concepts	Motivating Elements
A game in which students manage an agribusiness farm in a fictional country, allowing the evolution of students and teams independently, and with some association with real time to eliminate the need for decision rounds.	Entrepreneurship, Business Management, Accounting, Marketing, Logistics, Inventory Management, Supply Chain Management, Strategy, Production Management, Human Resources.	Different teaching method from traditional classes; Engaging game narrative; Competition among students for the best results.

Target	**Theme**	**Kinds of game**
Students in the undergraduate programs of Business Administration or Production Engineering.	Educational game aimed at integrating the knowledge acquired throughout the course and fostering the development of skills relevant to students' future professional endeavors.	In-person; Prototype of an individual game, with the prospect of promoting interactions between teams in the future;
Resources	**Benefits**	
Computer Excel	Provide students with the opportunity to experience everyday situations of a manager in a controlled environment, enabling them to prepare for the process of managerial decision-making and strategic analysis.	

Source: Author's own work (2022)

After some analysis by the working group that participated in the initial brainstorming, it was decided to make some adaptations to the initial model, exchanging some fields considered non-essential for others with more relevant information. The fields describing the concepts covered by the game, the essential guidelines, the motivating elements, and the definition of the target audience were retained. The remaining fields were replaced with new information: "Game Dynamics" provides more detailed expectations for the game, "Methods and Theories" signals the fundamental theoretical basis of this research, "Inspiration Games" lists some existing games in the entertainment market that can serve as benchmarks for constructing certain elements of the game, and "Skills and Competencies" aims to emphasize that, in addition to the content covered, the class with this game intends to stimulate the development of certain skills and competencies. Table 3 presents Business Game Canvas 2 with the specific adjustments of this research, encompassing all the guiding elements necessary for the creation of the game.

Table 3

Business Game Canvas 2 with the specific adjustments for this research

Guidelines	**Concepts**	**Motivating Elements**
Game in which students manage an agribusiness farm in a fictional country, allowing the independent evolution of students and teams, with some association with real time to eliminate the need for decision rounds.	Entrepreneurship, Business Management, Accounting, Marketing, Logistics, Inventory Management, Supply Chain Management, Strategy, Production Management, Human Resources.	Different teaching method from traditional classes; Engaging game narrative; Competition among students for the best results.
Target	**Methods and Theories**	**Game Dynamics**
Students in the undergraduate programs of Business Administration or Production Engineering.	Business Games Problem-Based Learning Experiential Learning Flow Theory Role-Playing Games (RPG)	Within the game narrative, students arrive in a new country to establish a new venture in agribusiness and must structure everything to initiate operations. The first challenge is to make the company operational and profitable. Then, the goal is to grow the business and expand.
Inspiration Games	**Skills and Competencies**	
Simcity[4] Tycoon[5] Hattrick[6] RPGs	Decision-making 21st Century Skills	

Source: Author's own work (2022)

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5.3 Artifact Creation

After creating the Business Game Canvas, the next step was to develop the artifact, which, in our case, is the game prototype, with its tests and validations.

Before describing the construction of the prototype, it is worth revisiting the idea of how to apply the characteristics of an RPG game to a business game. Salen and Zimmerman (2012)

[4] https://www.ea.com/pt-br/games/simcity
[5] Diversos jogos para computador onde o jogador administra algum tipo de negócio, como uma ferrovia, ou um shopping center.
[6] https://www.hattrick.org/pt/

point out that the particularities of an RPG almost all fit the definition of a game, but a possible barrier pointed out by the authors can be solved by applying it to a business game.

> "RPGs clearly incorporate all the components of our definition of a game, with the exception of one: a quantifiable outcome. As an RPG player, you move through the game's stories, following rules, increasing your character's skills. What is usually missing, however, is a goal for the game. RPGs are structured as serial narratives that grow and evolve with each session." (Salen and Zimmerman, 2012)

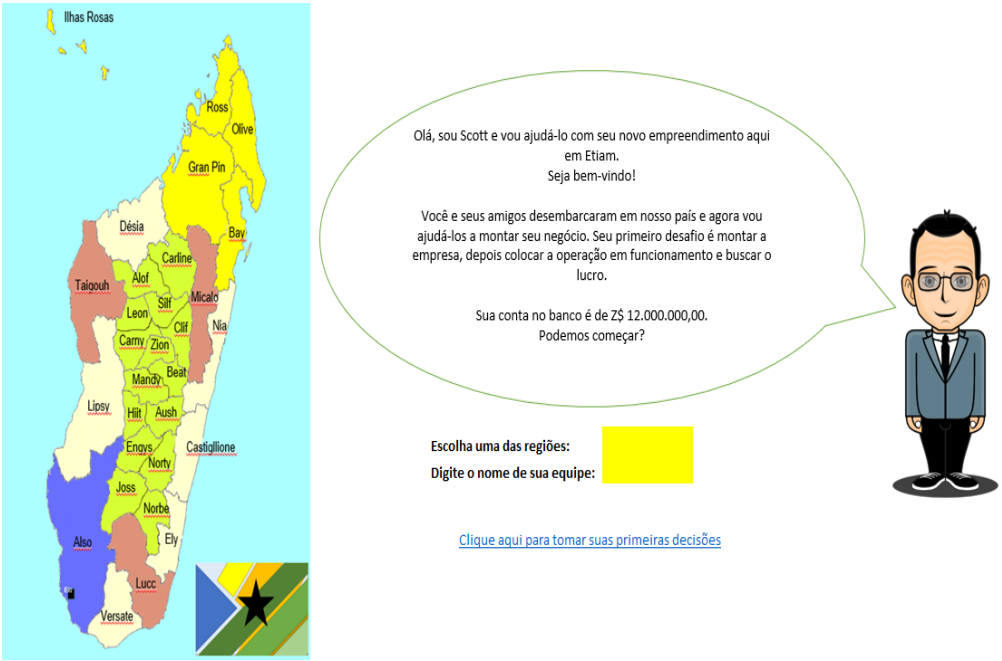
The serial and growing narrative is the element that has put the spotlight on role-playing games as an alternative to the model of games with decision rounds. Considering its application in a class with future managers, in the world of an RPG game, students will be able to choose different ways to make their companies evolve, just as it happens in the real world. In other words, from the point of view of the game, the application of an RPG seems feasible, but from the pedagogical point of view, the objectives of the subject must be carefully planned so as not to limit the possibilities of the characters.

Based on the experience of applying didactic games by the authors of this article, it is possible to observe that, in general, in the first few lessons, students usually take a reasonable amount of time to understand the dynamics of the game-based subject and their role in this teaching method. In order to make this moment an easier experience for the students, it was decided that the initial phase of the game should be inspired by Aragão's (2009) book-game RPG model, in which all the necessary decisions would be mapped out and strategically planned as if they were a decision tree (Salen and Zimmerman, 2012).

This initial phase will allow the student to familiarize themselves with the playful environment and the game's narrative, as it is shown in figure 2:

Figure 2

Game start screen

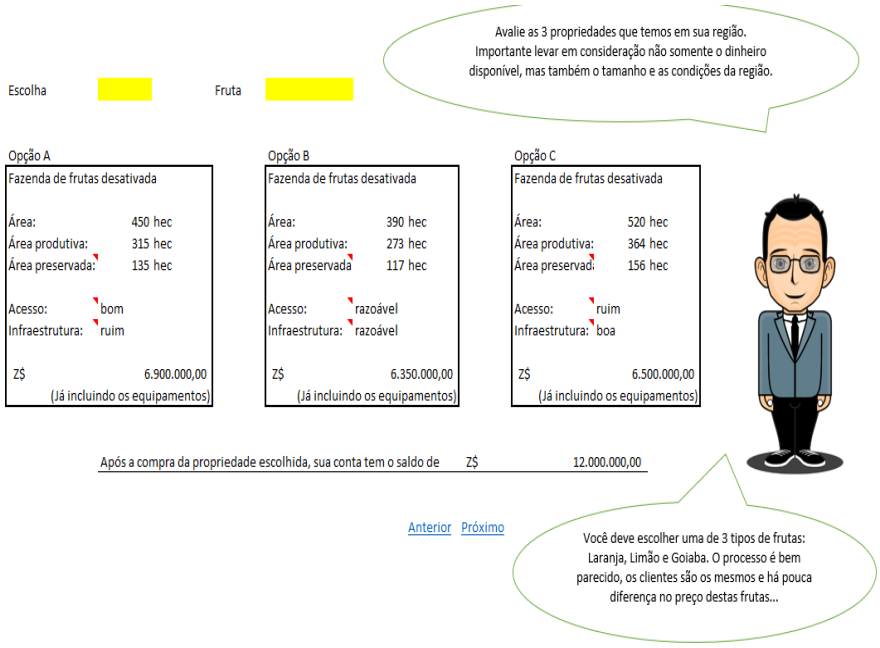


Source: Prepared by the author (2022).

When finished, the student progresses to the next screen and makes decisions to structure their company. Figure 2 illustrates the student's second decision in the game, which is evaluating 3 options of properties to buy.

Figure 2

Game screen to choose which property will be bought

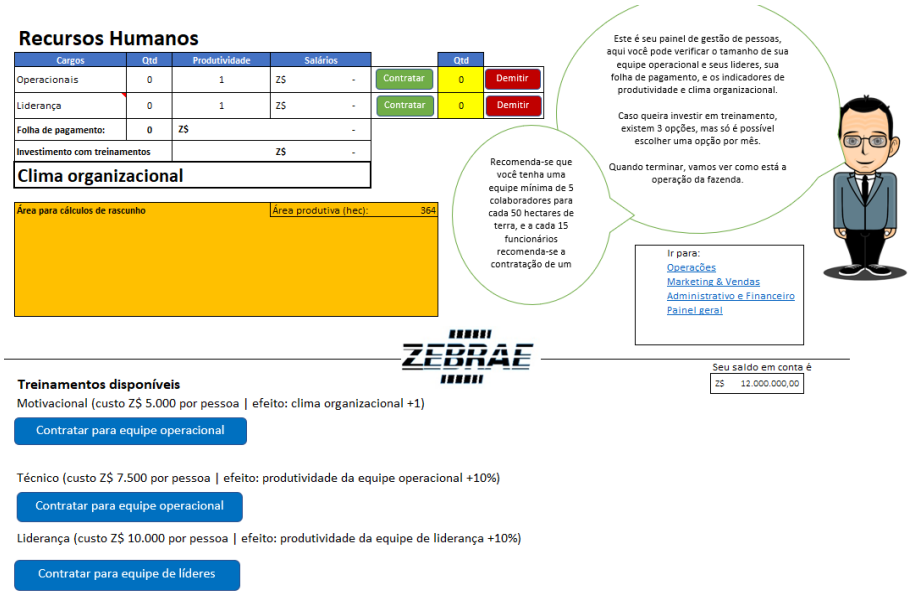


Source: Prepared by the author (2022).

In the next stage, after some initial decisions, the students need to set up their company before starting production activities. In figure 3, the students plan the operational team and its leaders, and may opt for training with "ZEBRAE" as well.

Figure 3

Decisions on human resources

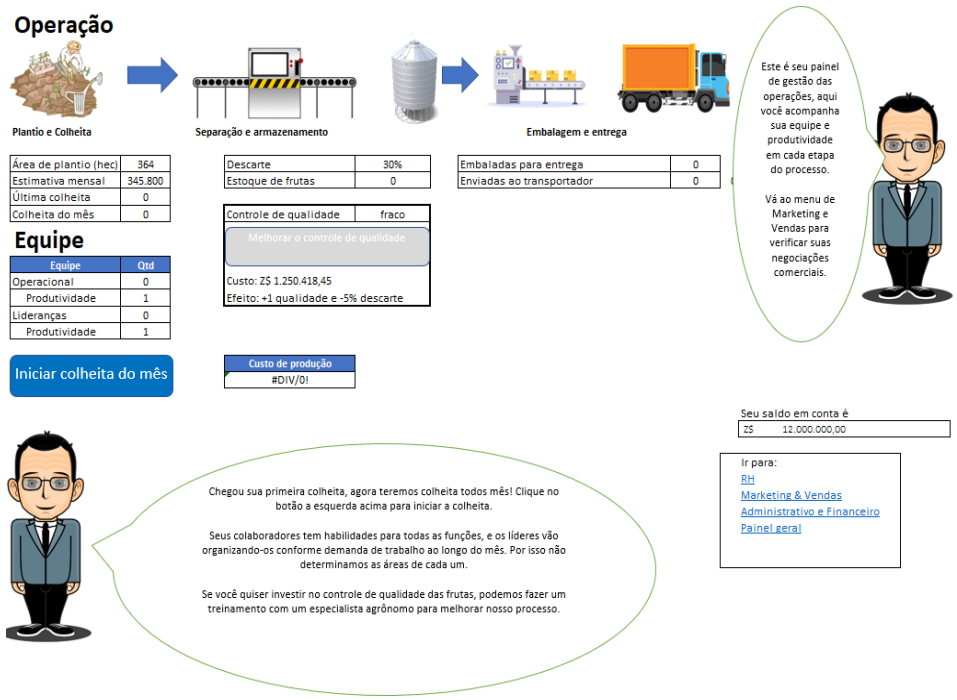


Source: Prepared by the author (2022).

The next stage of the game is the start of the harvest. According to the operational decisions shown in figure 4, students will be able to see how much fruit will be available for sale, and will also have the option of investing in quality control to avoid losses in the process.

Figure 4

Operational decisions

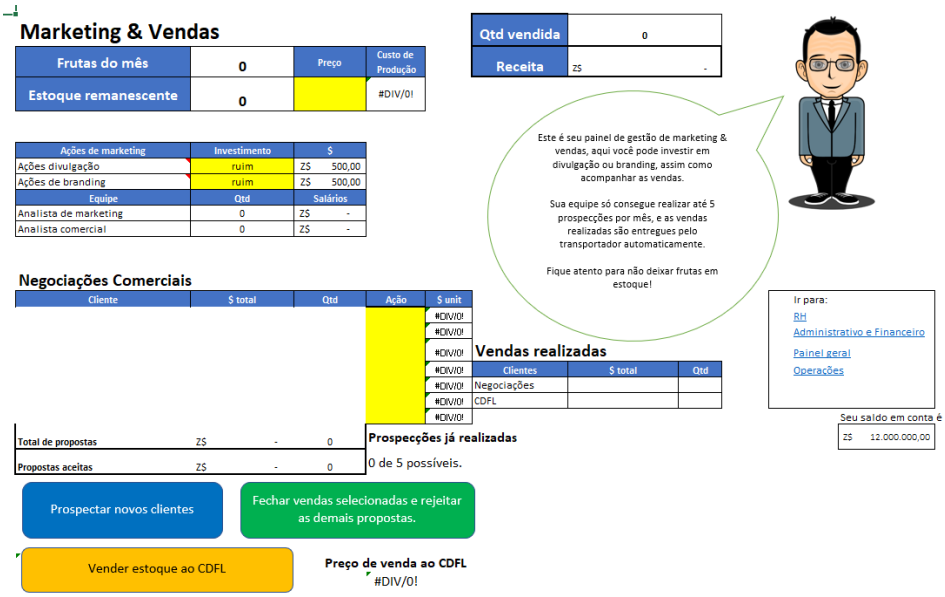


Source: Prepared by the author (2022).

On the next screen, students can invest in commercial promotion or branding actions, which will influence the prospect of customers being interested in buying the fruit. As shown in figure 5, students must click on the blue button to prospect for new customers and evaluate the proposals they wish to accept, being able to prospect up to 5 times a month.

Figure 5

Marketing and sales decisions

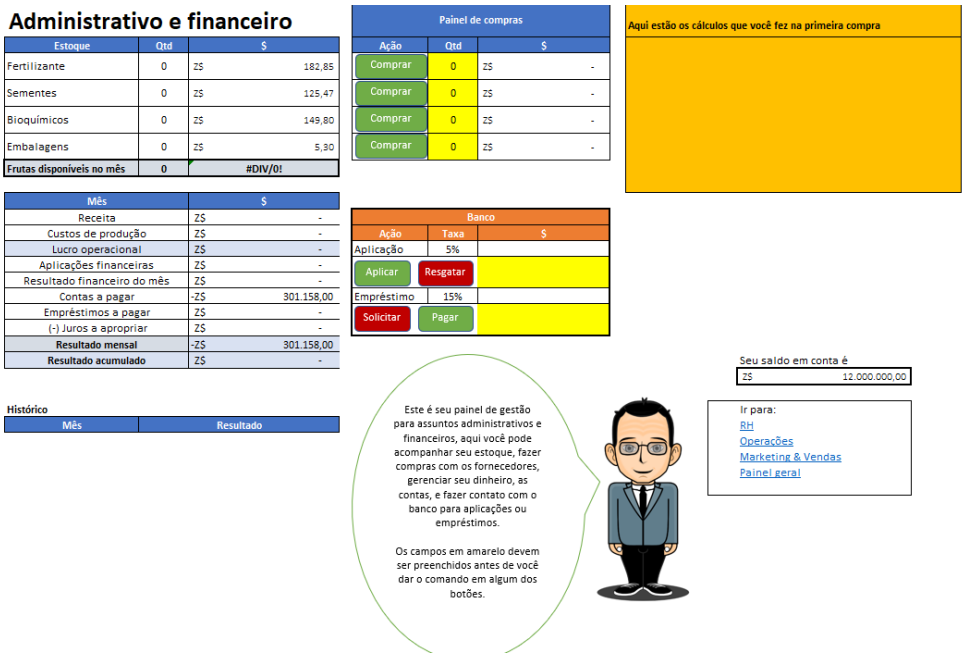


Source: Prepared by the author (2022).

On the administrative and financial decisions screen (figure 6), students evaluate their stock of inputs and can place orders with suppliers, as well as monitor their financial results, make investments or take out loans at the bank.

Figure 6

Administrative and financial decisions

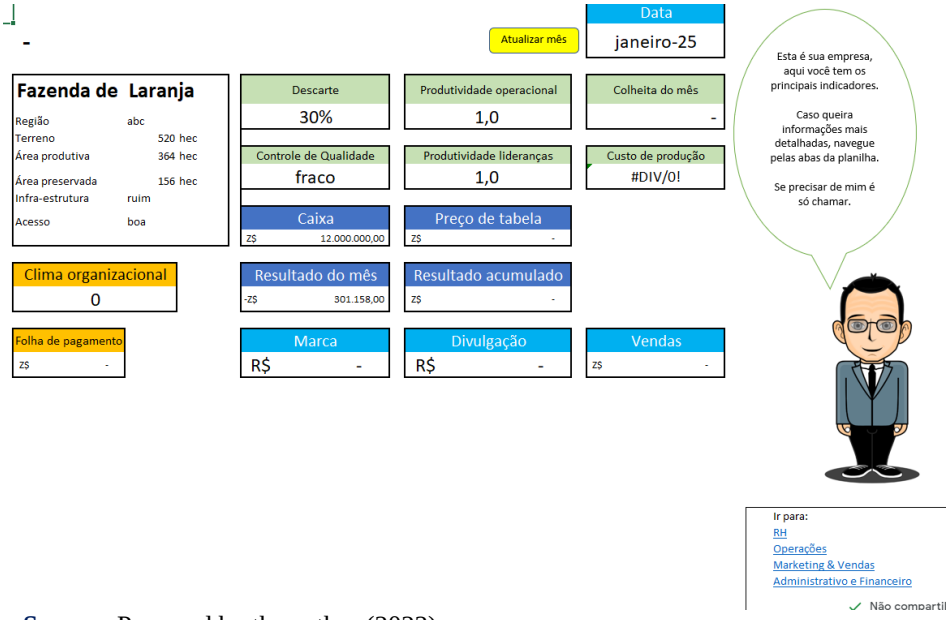


Source: Prepared by the author (2022).

On the last screen available on the prototype, students have a dashboard with various indicators to monitor their company's results (figure 7). Using these indicators, the professor can monitor the students' development in class, comparing their results with those of the class. Through the yellow button, the student can move on to the next month, updating the simulator with variables so that they can restart the cycle: harvest - sale. Each month, the student can always make new decisions related to human resources, quality control, training, marketing and suppliers, as they see fit.

Figure 71

Dashboard



Source: Prepared by the author (2022).

It's worth noting that during the brainstorming meetings to discuss the game's design, the idea of replacing the decision rounds with a direct association with real-life time was devised. This feature will only be applied in future developments of the game, when there is a more advanced system than the prototype in this research.

For the prototype, each student/player has direct control of clicking a button to move on to the next month when they are ready, thus meeting the need not to limit the students' decisions and allowing each one to evolve according to their learning.

5.4 Initial Tests on the Artifact

Before applying the artifact (the prototype of the game) with undergraduates, and throughout its development, various tests were carried out with experts in management, games or education to validate the functioning of the relations between a variable and its effect on the simulator.

The first version of the game contained static spreadsheets with a great deal of information to be analyzed. However, it became clear that, in such a way, the student would have no perception of a game and their decisions would not be clearly connected.

The second version failed even more quickly, as it tried to be developed in Access to allow the company's decisions and information to be processed. Technical reasons caused this version to be abandoned.

The third version of the prototype was inspired by traditional role-playing games, with several game sheets in "PDF" files that would be sent to the students as the simulation progressed. In the first phase of the prototype, this version met the needs well, requiring only an Excel file for the teacher to process the decisions. However, the second phase of the game didn't work with the "PDF" file model, causing long delays in processing the decisions and generating new files.

The fourth version used Excel again only in the second phase, considering that the first phase could be applied with the "PDF" files. Then, the students would use the file called *dashboard* to manage their company. In this version, the spreadsheets were not just static reports, but had various formulas, graphs and figures to simulate an integrated management panel. The criticism received about this version focused on the excess of information and, consequently, the delay in processing the students' decisions.

The fifth version of the simulator was created from a blank spreadsheet in an attempt to avoid the influence of previous versions. The screens and variables inserted in this simulator were designed to address the criticism of the previous version about the great amount of information. However, there was a minimalist excess, given that the biggest criticism of the fifth version was precisely that the small amount of information made it easier to process decisions, but did not provide players with the desired experience, the almost real feeling that they were running a company.

The sixth and final version was developed seeking a balance between versions three, four and five. The "PDF" sheets were replaced by Excel screens with buttons, formulas and macros, so that when the student reached the dashboard for the second phase of the game, the previous decisions were already automatically integrated into the system, without the need for teacher intervention. In addition, the prototype gained interactive buttons, which enabled the purchase of inputs and machinery, bank operations and commercial negotiations, without the need for the teacher to intervene.

Finally, in the sixth version, a mechanism was created that allowed the student to advance the game time to the next month when he was ready. Thus, despite the author's technical limitations in programming language, this latest version of the Excel prototype incorporated buttons and VBA codes, which made it possible to process the students' decisions in a given month and advance to the next month.

5.5 Evaluation of the results obtained

In the second semester of 2022, students from the "Business Games" subject in the administration course at Cefet-RJ were invited to voluntarily participate in tests with the artifact, the prototype of the game. A total of 12 students took part in this stage. After the initial presentation of the narrative by the professor, each student had approximately two hours to use the prototype and make their own decisions.

In order to validate the artifact, after the tests, the students answered a questionnaire based on Silva (2019), containing 60 statements, whose answers were on a scale of 1 to 7 relating to the extent to which each sentence sought to correspond to the student's thoughts about their experience with the prototype, with 1 being "Does not correspond in full" and 7 being "Corresponds in full". It is worth noting that the instrument chosen for this research was developed, applied and empirically validated by Silva (2019). Thus, this research achieves more credibility due to the statistical validation of the questionnaire, and also due to the equivalence of the audience analyzed, which, in the original study, were university students from a management course in Portugal.

5.5.1 Clarity

The category 'clarity' refers to the form the narrative was presented to the students, the contextualization of the environment, the game's objectives, the decision variables available to the students, as well as the rules and dynamics of the game itself.

To assess this category, four affirmative statements were presented: 'The overall objectives of the game were clearly presented'; 'I understood the learning objectives through the game'; 'The content of the game was efficiently presented'; and 'The rules of the game were clearly presented.' The results, presented in Table 4, suggest that the prototype received an excellent evaluation from students regarding the clarity of information and objectives.

Table 2

Statements associated with the Clarity section of the questionnaire

The overall objectives of the game were clearly presented.	6,5
I understood the learning objectives through the game.	6,8
The content of the game was efficiently presented.	6,6
The rules of the game were clearly presented.	6,5
Overall average for the category:	**6,6**

Source: prepared by the author (2022)

5.5.2 Challenge

The 'challenge' category aims to assess how much the game, in this case, the prototype, was challenging for the students. In other words, it examines whether the problems that arose during the game, the knowledge addressed, and the decisions made provided a stimulating experience for the student.

To assess this category, four affirmative statements were presented: 'The game was challenging'; 'The game forced me to use all my abilities'; 'The challenge provided is suitable, neither too easy nor too difficult'; and 'The game offers new challenges at an appropriate pace.' The scores presented in Table 5 suggest that the prototype received a good evaluation from students regarding the challenges offered by the game. However, when carefully analyzing the scores for each statement, the importance of choosing a validated instrument can be perceived: the first statement, which has a higher score, is a more generic and direct question and may be influenced by the researcher being the participating students' professor. However, when presenting three other statements with the same objective but describing details of what it means for the game to be challenging, the scores were slightly lower.

Table 3

Statements associated with the Challenge section of the questionnaire

The game was challenging.	6,4
The game forced me to use all my abilities.	6,0
The challenge provided is suitable, neither too easy nor too difficult.	6,0
The game offers new challenges at an appropriate pace.	6,0
Overall average for the category:	**6,1**

Source: Prepared by the author (2022).

5.5.3 Autonomy

The 'autonomy' category aims to assess whether the prototype provided students with a sense of autonomy in their learning through their decisions. In other words, this category seeks to measure the extent to which students perceived, through their decisions in the game, that they could control their outcomes.

To assess this category, four affirmative statements were presented: 'During the game, I felt a sense of control over my actions'; 'The game does not allow players to make mistakes'; 'During the game, I knew what the next step to take was' and 'I felt a sense of control over the game.' The results presented in Table 6 suggest that the prototype received a fairly average evaluation from students regarding their autonomy in the game. The scores obtained indicate that the prototype needs to provide more information about decisions and their respective consequences, so that students have greater control over their actions. Analyzing the scores for each statement, it is evident that, despite the statistical validation of the questionnaire, the second statement may have received a low score because it does not apply appropriately to the type of game analyzed in this research. This is because making a wrong decision in business games is part of the learning process, and it does not make sense to avoid errors.

Table 4

Statements associated with the Autonomy section of the questionnaire

During the game, I felt a sense of control over my actions.	5,4
The game does not allow players to make mistakes.	3,5
During the game, I knew what the next step to take was.	5,0
I felt a sense of control over the game.	5,3
Overall average for the category:	**4,8**

Source: Prepared by the author (2022)

5.5.4 Attitude

The 'attitude' category aims to capture the student's overall perception of their experience with the game – how productive, useful, and enjoyable it was to participate in this activity. To assess this category, three affirmative statements were presented: 'Using the game was important'; 'Using the game was a good idea' and 'Using the game was positive.' The results presented in Table 7 suggest that the prototype received an excellent evaluation from students regarding their experience with the game.

Table 5

Statements associated with the Attitude dimension of the questionnaire.

Using the game was important.	6,6
Using the game was a good idea.	6,9
Using the game was positive.	7
Overall average for the category:	**6,8**

Source: prepared by the author (2022)

5.5.5 Intention to continue using the game

This category is self-explanatory, as its goal is to check whether the students who finished the tests intend to continue using the game. To assess this category, three affirmative statements were presented: 'I anticipate continuing to use the game in the future'; 'I intend to use the game as frequently as I have done so far' and 'I anticipate using the game more frequently than less frequently.' The results presented in Table 8 suggest that the prototype achieved a fairly average evaluation from students regarding their intention to continue using the game. When analyzing the results of this category, it can be considered that there may have been some interference from the testing process itself. Since the students were aware that it was a test with a prototype, they would not use it again in the course.

Table 6

Statements associated with the Intention to continue using the game section of the questionnaire

I anticipate continuing to use the game in the future.	5,1
I intend to use the game as frequently as I have done so far.	5,2
I anticipate using the game more frequently than less frequently.	4,5
Overall average for the category:	**5,0**

Source: prepared by the author (2022)

5.5.6 Perceived Learning

This category is also self-explanatory, as its goal is to assess how much the student perceived that they were learning from the experience with the prototype. To assess this category, fourteen affirmative statements were presented. The results presented in Table 9 reveal that the prototype achieved an excellent evaluation from students regarding their perception of learning. It is worth noting that the penultimate statement has a negative sense in relation to the others and is part of Silva's original study (2019). Therefore, a lower score for this statement indicates that the student considered the experience relevant.

Table 7

Statements associated with the Perceived Learning section of the questionnaire

During the game, I felt that I was learning accounting.	5,8
Playing the game increased my knowledge and understanding of the administration course.	5,9
I use the contents of the game to enhance my knowledge of the administration course subjects.	5,5
While playing, I felt confident that I could learn the course content.	5,9
I feel that I learned as much in these classes as I did in traditional classes.	6,5
I feel that I learn more with the game than in I do traditional classes.	6,2
The quality of the learning experience with the game is better than it is in traditional classes.	6,5
Whether the content is easy or difficult, I am sure I can learn.	6,5
I can easily apply the knowledge learned with the game to the real world.	6,6
I believe the game can help improve the efficiency of my learning.	7,0
I believe the game can help improve my learning performance.	6,9
I learned some unexpected and surprising things from the game.	6,5
The game was not relevant to me because I already knew most of the content.	2,1*
The good organization of the contents of the game helped me learn more effectively.	6,6
Overall average for the category	**6,3**

Source: prepared by the author (2022)

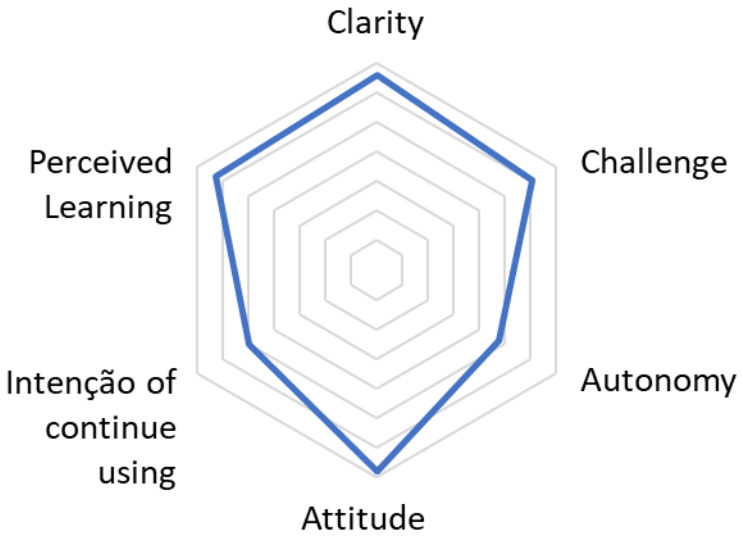
5.5.7 Final Evaluation of the Students' Experience with the Prototype

Through the results, it was possible to observe that the prototype met the needs of a business game course successfully since the students had a good experience. Moreover, as seen in Graph 1, it is natural that there are still some points to be improved in a prototype. Students rated the sections Clarity, Challenge, Perceived Learning, and Attitude with excellent scores,

while the section that assesses the students' level of interest in continuing to use the prototype had a good rating. Autonomy was the lowest-rated section in this sample.

Graph 1

Consolidation of student evaluations for various sections of the game prototype



Source: prepared by the author (2022)

6 Final Considerations

Critiques of the more common format of business games, with decision rounds, led to the need to create a new game that would allow teams to develop independently while playing. With the research goal of creating a new artifact that would offer a good experience to students, the Design Science Research method was chosen. Below, the results in light of the guidelines established by Hevner et al. (2004) are presented.

The research objective was achieved through the creation of a game (guideline 1 - artifact design) that was characterized as a teaching tool in Administration, developing students' decision-making skills through a dynamic which did not involve decision rounds. This would allow independence of results between teams and increase their involvement in the learning process. This proposal proved to be innovative (guideline 2 - relevance of the problem) as no artifacts with the same characteristics were found in the literature.

The prototype was tested by undergraduate students who evaluated it according to seven criteria: clarity (average 6.6 out of 7), challenge (average 6.1 out of 7), autonomy (average 4.8

out of 7), attitude (average 6.8 out of 7), intention to continue playing (average 5 out of 7), perceived learning (average 6.3 out of 7). The results were considered satisfactory as they received high scores in most criteria, also indicating opportunities for future improvements. Therefore, we consider guideline 3 (artifact evaluation) fulfilled.

Contributions to research (guideline 4) are associated with its effectiveness as a teaching tool in Administration. Such effectiveness can be confirmed by the responses to the sixth question of the student evaluation questionnaire – an average of 6.3 on a scale of 1 to 7 was obtained, which can be considered excellent.

The research followed the previously defined procedures (guideline 5 – research rigor), using Design techniques such as brainstorming and co-creation (guideline 6 - Design as a research process). Finally, it is emphasized that this article constitutes a form of research dissemination, meeting guideline 7 (research communication) of Hevner et al. (2004).

From an educational perspective, this research aligns with the United Nations' fourth Sustainable Development Goal: Quality Education. Despite many publications on the use and application of business games, this research adds a complementary view by considering a new alternative business game without decision rounds, allowing teams to develop independently within the game.

AUTHORS' CONTRIBUTIONS

Contribution	Oliveira, PHP	Sasaki, DGG	Miyashita, R
Contextualization	x	-	-
Methodology	-	x	x
Software	x	-	x
Validation	-	x	x
Formal analysis	x	x	x
Investigation	x	x	-
Resources	x	-	-
Data curation	x	-	-
Original	x	-	-
Revision and editing	-	x	x
Viewing	x	-	-
Supervision	-	x	-
Project management	x	-	-
Obtaining funding	-	-	-

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