Considering Game Type Criterion to Design Game-Based Learning and Gamification

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Abstract

Game-based learning (GBL) can make learning more interesting and appealing by incorporating educational lessons into games. Using game-type criteria to design the solution provides expanding opportunities to engage students in learning. When the subject matter is non-trivial and requires a significant effort to master, integrating a game into the curriculum should provide advantages if the game design is directly tied to the learning objectives. Students require multiple streams of information, prefer inductive reasoning, need frequent and quick interactions with content, and have strong visual literacy skills (Tang et al., 2009). These student requirements match features provided by GBL and gamification. When reviewing your learning objectives design games around a number of players, the rationality of players, the cooperation required, and the sum of the payoffs to the players. During game design consider pedagogical components and facilitation, student motivations, learning theory and game types, and structure of GBL opportunities for teaching and learning.

Keywords: game-based learning, gamification, game type criterion, game design, pedagogy, facilitation, student motivation, structure

I. Introduction

A study conducted by Kapp (2014), stated that game-based learning (GBL) incorporates a fully developed game with three essential elements players, strategies, and payoffs to deliver skill and knowledge. The game has a defined start, gameplay, and ending state. There is a win state for learners engaged within the game. Gamification only employs a small number of game elements. The student does not interact with the whole game from start to end, and they get involved in a session that utilizes game elements such as getting awarded for finishing a task or problem, coping with an obstacle or challenge, and achieving points. Game-based learning is sometimes employed as a one-period instructional occurrence to give formal learning in a classroom or online. Otherwise, gamification does not always take place in a synchronous setting. The game can be delivered to a learner's digital device (Kapp, 2014).

There are several considerations used to construct or select elements of a game that are essential for GBL and gamification. The game needs to connect the learning objectives with student interaction (Checa, Miguel-Alonso, & Bustillo, 2021). This is considered in multiple ways. First, the connection between how the learning objectives is included in the game experience (Bado, 2022) and facilitated by the instructor should be understood in detail by the instructor. Second, the design of the game must be tied to the instructor's ability to incorporate the use of the game in the classroom or online. The seamless integration of the learning material to the game experience and narrative should

create a high potential for learning (Rahmadi, Lavicza, & Houghton, 2021). During game design consider pedagogical components and facilitation, student motivations, learning theory and game types, and structure of GBL opportunities for teaching and learning.

II. Pedagogical components and facilitation

There is an educational philosophy, style, and approach to promoting learning in educational contexts using video games and non-digital games that incorporate the learning principles and techniques of games and gamification. GBL requires that a knowledgeable instructor facilitates the game, the game is carefully integrated with the learning objectives, and that students under the watchful guidance of the instructor are receptive to the game as an educational experience (Nizar-Moses, 2022). Integration of GBL requires that the instructor observe how the game is used by students. Discerning these observations, the instrumentation of the game should be adjusted during future iterations (Aslan et al., 2022). If the incorporation of GBL is not a complete success in the first iteration, the instructor and game design should be altered to increase the effectiveness of the game in the future.

The instructor is responsible for considering interactions and developing instruction in small chunks based on tasks the students can perform independently and as a group. It is not possible for the game to teach students everything they need to know without the assistance of the instructor. Games should be integrated as part of a larger lesson and facilitated with additional instructions to guide students through the game and related learning activities. There should always be an activity to facilitate discussions after engaging in GBL for two reasons (Li et al., 2021). The first reason is to determine what individual students have learned. The second reason is for students to share what they have learned with each other. The instructor facilitates the debriefing activity as a discussion or other group activity to ensure that the learning objectives are understood and that students have acquired a complete mental representation.

III. Student motivations

The audience should be an important consideration for the educational game being designed. A 2022 survey published by CenturyLinkQuote.com studied gaming habits in Americans ages 16 to 54+. The study was conducted through a survey of 1,000 Americans and then divided by their generations: Gen Z (16–24 years old), millennials (25–44 years old), Generation X (45–54 years old), and boomers (54+ years old). Generation Z clocked the highest percentage of regular gamers with 73%. The survey found that most Americans whom game do so on their mobile devices rather than a console because of the convenience of having a console in their pocket. Call of Duty: Mobile was the most popular game, followed by Roblox and Minecraft as a tie for second (Walker, 2022). Since most of their students will be familiar with games there should be an immediate advantage to instructors implementing games for education.

This presents two disadvantages of implementing GBL. First, because students are exposed primarily to commercially available, high-budge video games, students will expect a high-quality game as part of the graphics and the final product (Liberona et al.,

2021). Second, students may not be proficient in the specific type of game being used for the purpose of education (Liberona et al., 2021). There are students that will not like using games for the purpose of education and rather than encouraging these students, the game may discourage them from the learning process. Knowing this situation is possible the instructor should prepare for this and handle as planned when the situation is encountered. If resources and time allow, it might be beneficial to include a non-GBL version of the lesson to accommodate these students.

IV. Learning theory and game types

Students who are more internally motivated are more likely to have a positive experience and succeed using an educational game (Kalmpourtzis, 2018). For this reason, it is important to build the motivations of their players or students into creating a productive educational game experience. The factors that motivate students to play games are not new; Malone and Lepper described a taxonomy of motivations within the context of an educational situation (Malone and Lepper). Each subcategory in the taxonomy of motivations is grounded in existing educational theory.

The taxonomy is divided into two major types of motivation (Nizar-Moses, 2022). The first is individual motivations. This contains the categories of challenge, curiosity, control, and fantasy. The second section is about interpersonal motivations that contain the student-to-student interactions of cooperation, competition, and recognition. The individual motivations need to be incorporated into the game environment by including goals, uncertain outcomes, performance feedback, audio, and visual enhancement (Yamani, 2021). GBL will be enhanced by a responsive learning environment that allows students to make choices that generate effects (Bado, 2022). Students need to identify with game characters and the game narrative needs to match the intended educational topic (Rahmadi, Lavicza, & Houghton, 2021).

Game types can be organized according to various criteria. The first game type uses the number of players as a criterion. The maximum number of players is finite. A player may be expounded as a nation, or a team comprising many individuals. Games are categorized as one-person, two persons, or n-person (n>2) game. The second game type is to use the rationality of players as a criterion. A key supposition in many games is that the players are rational. A rational player is one who always chooses an action that gives the outcome he prefers, given what he expects his competitors to do. The other extreme is the player who always chooses random actions. The third game type uses cooperation as the criterion. Games can be categorized into cooperative and non-cooperative. A game in which players are allowed to cooperate with each other on a joint strategy is called a cooperative game. For non-cooperative games, the basic assumption is that individual players cannot cooperate. The fourth game type is the normal and extensive criterion. The normal form is the basic type of game studied in non-cooperative games. A game in normal form lists each player and the outcomes that result from each possible combination of choices. The extensive form, which is also known as a game tree, is more detailed than the strategic form of a game. It is a complete description of how the game is played over time. The fifth game type is the constant-sum and non-zero-sum game. Constant-sum games have the property that the sum of the payoffs to the players equals

zero. For example, chess, poker, and most sports game are constant-sum games. In non-zero-sum games, all players could win or lose together. For example, price wars between firms are non-zero-sum games. In non-zero-sum games, players have common and conflicting interests (Geckil et al., 2010).

Interpersonal motivations are incorporated into the type of game created. The decision on whether to implement a single-player or multi-player game should have significant implications for both the game facilitation and the game design (Kortmann & Peters, 2017). A single-player game will be the simplest to implement. In a competitive, multi-player game where students interact with each other, they may be more sensitive to the issues of game balance and fair play. This could increase the amount of testing required before the game can be used for teaching and learning. To ensure that the game is cooperative special attention must be paid to the design for the interactions between different players and how these interactions affect the educational context of the game (Kortmann & Peters, 2017). From a technical standpoint, multi-player games require additional time and resources to implement. The final game will require a network to facilitate game play. The hardware aspect of the server can increase the difficulty of maintaining a functional game environment and might require additional support and configuration from information technology departments. The software aspect requires software development as an additional component that will need to be maintained as part of the game. Some aspects of the multi-player game can be simulated using single-player games with an adequate scoring system (Kortmann & Peters, 2017). Scores in single-player games can allow players to compete against each other or cooperate with each other.

V. Structure of GBL Opportunities for Teaching and Learning

The structure for the game is provided by rules. Rules describe how features work within the game. The rules need to provide a fun experience that provides education. The structure and associated rules need to closely match the topic of learning. In this way, the structure of the game will regulate game balance. Game balance is the ability to create equilibrium between game achievement and the difficulty of the tasks to perform. The correct balance creates a game that is fun for each student. One indication of good balance is described in the media effects flow theory originally defined by Csikszentmihalyi and applied to the video game by several others (Csikszentmihalyi). If players cannot achieve the goals of the game, they will not enjoy the game experience. The same is true if the game is too easy, students will not enjoy playing the game. This theory is supported by the motivational factors of challenge and control proposed by Malone and Lepper (Malone and Lepper).

Educational games are a part of digital games where fun, entertainment, and enjoyment, are not a primary objective of the game but are used as strategies to deliver the real purposes of education, training, or basic knowledge in a particular area. GBL and gamification are designed to get rid of drill and practice as a primary method for delivering learning content, offering the richer concept of solving a puzzle, participating in a role-playing game, or completing a simulation. GBL can be regarded as educational games where the game is developed to deliver immersive and engaging experiences to

achieve a learning objective that provides experiences and results (Tang et al., 2009). The purpose of GBL and gamification is the educational content derived from learning objectives or essential life skills to enhance the learning experience. Gamification is used to implement game elements and not a fully developed game into a non-game environment.

As an example, gamification was used to teach the Cuban Revolution of 1959. The learning objective was for students to have an increased awareness and understanding of the narrative history of the Cuban revolution. They were to focus on the causes and aftereffects by analyzing historical essays, source material, and videos. The instructor provided a narrative lecture. Students completed reading and writing assignments associated with the information from the lecture and developed avatars to represent different groups of people. These assignments allowed students to think critically about the multiple sides of the complex debates surrounding the Cuban Revolution. Students would then participate in a virtual world assignment. As a class, they scripted stories and exchanged in collaborative discourse to form a shared understanding of the concepts they had learned throughout the week (Wakefield et al., 2012). Over time the virtual world could be expanded and developed into a GBL application.

VI. Conclusion

GBL requires that the game is carefully integrated with the learning objectives. Review the requirements and determine whether the best implementation of the game is for one-person, two persons, or multiple persons. For higher-level objectives that are scaffolded into multiple skills, there might be several games for different numbers of players. Using the Cuban Revolution of 1959 example, each player developed a character or avatar for the virtual world and later all players interacted in the virtual world. The second game type criterion to consider is the rationality of players as a criterion. When the game is played consider whether students will choose preferred or random actions and how this will affect gameplay. In the Cuban Revolution of 1959 example, the players were developed as avatars from the historical event. Based on the specific biases of the avatars developed extremes should assist in achieving the course objectives. The third game type consideration is cooperation. The choice to create a cooperative or non-cooperative game will be tied to the learning objective. The instructor needs to be a knowledgeable facilitator to manage the narrative and build the motivations of their players or students into creating a productive educational game experience. A cooperative game could be a bargaining game between players to determine the value of a new product. A non-cooperative game is effective for learning the analysis of strategic choices. In the Cuban Revolution of 1959 example, the instructor is facilitating a non-cooperative game. The normal and extensive criterion is the fourth game type. The game design will need to determine whether the result of the game produces each possible combination of choices (normal) or a complete description of how the game is played over time (extensive). In the Cuban Revolution of 1959 example, both the normal and extensive criterion could be used. The normal criteria would be used for the game being played in the current course but could provide a summary of the results of previous game

play to bring in any existing content that could benefit learning. The fifth game type is the constant-sum and non-zero-sum game. Constant-sum games have a winner and a loser whereas non-zero-sum games have all the players winning or losing together. The students playing the Cuban Revolution of 1959 game were playing a non-zero-sum game with players having common and conflicting interests.

GBL and gamification require that students be under the watchful guidance of the instructor. For the game to be successful students need to be receptive to the game as an educational experience (Nizar-Moses, 2022). Integration of GBL and gamification require that the instructor observe how the game is used by students. Analysis of these observations will allow for the adjustment and the instrumentation of the game for future iterations (Aslan et al., 2022). If the incorporation of GBL is not a complete success in the first iteration, the instructor and game design should be altered to increase the effectiveness of the game in the future.

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