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Development of Active Learning With Simulations and Games

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Educational games and simulations are excellent active learning tools that offer students hands-on experience. Little research is available on developing games and simulations and how teachers can be assisted in making their own games and simulations. In this context, the paper presents a multi-step process of how to develop games and simulations in the areas of business, finance and economics. This model for creating games and simulations can be successfully integrated into the process of developing efficient tools that create positive learning outcomes.

Keywords: multi-step process, development of games and simulations, active learning, positive learning outcomes

Introduction

Simulations and games have been receiving serious attention as an active learning strategy. Simulations and games require students' participation and decision-making throughout the learning process, and they allow practicing real-life behaviors in a realistic environment. The effectiveness of active learning with simulations and games depends directly on the design of the experience. Not much of research has focused on how to develop games and simulations. Designing simulations and games emerges naturally from the study and use of existing ones. This paper provides discussion on designing simulations and games. The techniques described can be used to create custom experiences or exercises that can be used in any classroom.

Literature Review

Active learning in the college classroom has been strongly advocated (Maier & Keenan, 1994; Smith, 1992) and used to promote educational goals in a variety of college disciplines. It requires students to work together in small groups to experience, analyze, criticize and solve problems instead of simply taking notes (Cooper & Mueck, 1990). Active learning provides practical experience and promotes learning via experiential learning techniques. For example, active learning with simulations and games enables students to actively experiment, test and apply what they have learned in other and more complex situations. The goal is to let students experience something new and then encourage reflection about their experience. This reflection helps active learners develop new skills or new ways of thinking (Kolb, 1984; Lewis & Williams, 1994).

The structure of a simulation or game is quite important as games and simulations seek to exercise fundamental concepts. For example, the free rider problem in economics may be very simple in structure (Lewis & Wentworth, 1971; Wells, 1991). In this case, multiple repetitions of a simple game must be conducted in order to illustrate the principle. Other games that seek to model complex operations, like the

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operation of a commercial bank, may have many aspects that must be mastered (Walker, 1987). Complex games can take weeks to complete. While both short and long games have their uses, many instructors find that it is desirable to have a game that takes a single class period and illustrates a specific concept (Brozik & Zapalska, 2000) or can be used to identify and develop specific behavioral characteristics (Zapalska & Brozik, 2001). These one-period simulations and games have the advantage of being flexible in their application, and instructors can change plans according to the needs of the class and move the game to a different time without causing major disruptions in the class schedule. When a one-period game is properly designed, it can become a valuable tool for the instructor, a tool that provides flexibility along with educational content (Zapalska & Brozik, 2001).

Simulations and games have proven their value both in and out of the classroom. Modifying a lecture to enhance students' learning by using active laboratory market experiments has been advocated by the Joint Council on Economic Education. But, the question of designing these exercises still needs clarification. Simulations and games do not just fall from trees. In order for a simulation or game to have the desired effect, it must be consciously constructed to that end. This paper presents such a method of construction.

Definitions and Terms

A "game" is exercise that has a winner. The winner of the game is the individual or team that first successfully completes the requirements of the game. The game essentially provides a competitive setting for learning specific subject matter. In contrast, a "simulation" models a portion of reality in a controlled setting and can reproduce the social, economic or political processes of particular systems of interactions. Students assume roles in the system and try to understand how the system operates by participating in it as members, not merely as observers. A simulation does not have a winner, since its focus is on situational learning. A "simulation game" is a combination of the two techniques that uses the role-playing of a simulation for learning specific concepts and has a winner. The active and competitive nature of a simulation game can encourage students by providing a motivation for learning.

Simulations are simplified reality and the essence of physical or social systems of interaction. They attempt to replicate essential aspects of reality, so that reality may be better understood and controlled. Reality is replicated to the degree that the simulation designer selects essential elements from reality. In contrast, games are competitive interactions among participants to achieve pre-specified goals. These interactions may feature cooperation within groups, but competition either among individuals or groups distinguishes gaming from simulation. There might still be competition in a simulation, but the focus of the exercise is experiential. Games are usually played for entertainment and clearly identify winners and losers. Participants' success is dependent upon skill or chance or some combination of the two. Games make no attempt to replicate real-world behavior and rules of behavior for the game need apply to the game only.

From these two ideas, simulation to represent elements of reality and gaming to stimulate interaction and simulation games have developed as powerful learning constructs. Creating a "winner" inside the context of a simulation provides a driving force for the participants to understand the environment and be successful. Though there are fundamental differences in the three types of exercises, for the purposes of this paper, the terms "game", "simulation" and "simulation game" will be used interchangeably, unless there is a particular reason to highlight the differences.

Every simulation and game must have a purpose and game must have a structure. These purposes and

structures combine to form different types of simulations and games. Although the following examples may not represent mutually exclusive categories, they do serve to differentiate among the variety of simulations and games. For example, non-simulation games are competitive learning exercises in which a participant's success is determined by the degree that the desired goal is achieved during the game play. Inter-personal simulations/games are learning exercises in which the participant responds, as if he/she were in the actual system being simulated. Interaction is structured by rules and physical circumstances. Large system simulations/games are exercises for the examination of the dynamics of complex systems of interaction. The focus may range from examining the variables affecting a business community to an analysis of the nation-state system of the international community/market. The participant is engaged in the simulated system as a planner, a decision-maker, or an observer in order to better comprehend the variables affecting the dynamics of human and business behavior within the context of the system being modeled.

A simulation or game is a complex structure that can be viewed from many different directions. The success or failure of a simulation or game will depend on how well it is designed and whether or not its complexity is appropriate or overpowering. One benefit of complexity is that there may be opportunities to modify the exercise to achieve other purposes. A robust structure can result in a family of games, each with a specific educational purpose.

Developing Simulations and Games

The development of a simulation or game is a multi-step process and it must be designed to meet the requirements of the task. Before attempting to write a game, there are several preliminary steps that must be completed.

Define the Goal of the Exercise

The purpose of the exercise must be unambiguous. The goal may be to demonstrate or learn a fact, a skill, a behavior or some combination of the three. A key aspect of a successful game is that it addresses a limited set of actions. Attempting to do too much within a single exercise will make a game unworkable. Be aware that as the exercise develops, the questions might change. This indicates that the initial questions were incorrect or too limited. It may also indicate that there are multiple facets to the exercise that should be addressed separately.

Identify Available Resources

An exercise can be designed that requires a complex computer set-up or a simple piece of paper. Players may be required to sit in one place or move around a room. The physical resources may depend on the exercise or they might help define the exercise. As a general rule, it is better to work with a simple infrastructure. The fewer the physical requirements, the more portable the game is. It might be desirable to place artificial constraints on the environment, for example, having players sit very close together or very far apart or forbidding speech. Such artificial barriers can serve to demonstrate the goal of the exercise by channeling activities more directly towards it.

Define the Use of Rewards, Randomness and Stress

The presence of a reward determines whether the exercise is a simulation or a game. The lack of a reward can lead to more cooperative behavior between participants. The presence of a reward can lead to competition, especially if the reward is significant. It is often enough to offer the winners some bonus points on the next examination. An example of a random factor would be using dice to determine the exchange rate between two

currencies in a specific period. The design of the game would have to include a predetermined probability distribution of the possible outcomes in order for the participants to have information available for their decision-making. The advantage of randomness is that it more accurately models the real world. The level of stress that will be induced in the players must be determined prior to the design of the game. Some stress is necessary for learning to occur.

Determine if the Game Will Be Winnable

Games have winners, by definition, but there is no requirement that the game can be won. Valuable lessons can be learned from failure, even if everyone fails. An example of this occurs in a foreign currency hedging game. Players are told that, if they can earn a profit after four rounds, they will receive bonus points on the next examination. The game is constructed, so that the probability of making a profit is small and depends on some lucky decisions and good dice rolls. This low probability of winning was designed into the game, since it is one of the goals of the game to demonstrate how difficult it is to make a profit in these markets. Whether they win or lose, players come to appreciate the difficulty of beating this market.

Determine if There Will Be Individual Players or Teams

Some lessons can only be learned individually, but many can be learned in a team setting. The use of teams simplifies scorekeeping in a game. It also requires players to use interpersonal skills in reaching decisions. This interaction is often a valuable factor, since the players are in reality teaching each other about the game. The size of a team is important. There should be at least three people in a team, so that there can be problems with intra-team communications. If there are more than five people in a team, it is difficult to design enough important roles to keep them all busy. Team sizes of three to five seem to provide the best operational characteristics.

These preliminary steps must be thought through prior to beginning work on the game. The actual creation of the game should flow smoothly from the established goals and boundary conditions. The following steps illustrate the process.

Create the Environment

Each simulation or game occurs within a conceptual framework. This is the “story” into which the players are inserted. If the goal is to illustrate how foreign exchange rates are set, the environment must become a currency trading room. If the goal is to demonstrate hiring techniques, an environment of employers seeking workers and workers seeking jobs is needed. The environment does not have to be completely accurate or all encompassing. It is only necessary to identify the slice of the environment relevant to the goal of the game and present it in a simplified format. By defining a compact environment, the learning goals can be achieved more quickly and efficiently.

Create the Roles for the Players

In the real world, each person has a role that he/she plays in a specific environment and in which created for a game each player must understand the goals, resources and action options which can be used in the game. The player must know what is to be done and the boundary conditions. This is where rewards are specified so that players will know how they will benefit from the success of their efforts: define the motives and purposes of the players as specifically as possible; do not specifically reveal areas of potential conflict or cooperation between the players. The learning process involves discovering these aspects of behavior.

Create Transactions and Rules

The substance of a game is the sequence of transactions between the players. It is important to formulate a broad, general idea of the sequence of what each player will do during the game. All transactions should lead to the learning goals. The rules must be written at this stage. The rules tell the players the manner in which transactions can or cannot be performed. It is a good idea to keep the rules as simple as possible. The initial design of the game should have as few rules and restrictions as possible.

Create an Evaluation Method

The notion of game implies there will be winners and losers. Simulations do not produce winners or losers but illustrate a process which can be evaluated as good or bad, valuable or not. It is easy to design a simple scoring system for a game to determine the winner. In simulations, the evaluation system is likely to be more anecdotal. Regardless of whether the exercise is a simulation or a game, it is important to be able to evaluate the situation. It is important to identify the goals and how they can be measured, numerically or otherwise. One possibility is to measure them in terms of how well a player's personal objectives are met by counting items or looking at an overall portfolio of items. Another approach is to focus on behaviors and this can focus on how players interacted with each other or the success of the group as a whole to meet the specified objectives.

Play the Prototype

The previous steps created an environment, roles for the players, transactions to be completed and evaluation methods. It now remains to perform the exercise with an appropriate group of players. It must be remembered that it is highly unlikely that the exercise will be complete at this phase. There is always some detail missing and the players themselves will add different dimensions to the experience. While it is not possible to specify exactly what to watch for during playing the game, the following questions may serve as guidelines: Was sufficient time available for the exercise?; Did the game instructions work well?; Did the players adapt to their roles easily or with difficulty?; What unanticipated behaviors occurred?; Was there sufficient time for a debriefing?; Did the exercise achieve its planned goals?; and Did the exercise achieve any unplanned goals?.

Modify the Prototype

The first playing of the game will reveal some aspect of the game that the designer had not anticipated. Even if the game flows smoothly and achieves the desired goal, that goal will be achieved via some unplanned and unforeseen combination of events. The designer must now modify the game to achieve exactly what was wanted or to incorporate the new information. This is actually one of the most interesting parts of the design process. No matter how much experience a game designer has, there is always something new to learn.

Replay and Redesign

Every time, a game is played, it is like playing a prototype game. Some games that have a long life and many plays behind them are fairly predictable in their outcomes, but every new set of players takes the game in a slightly different direction. The designer must be attuned to the subtleties of these changes and adapt them to future plays of the game.

Using Debriefing Sessions

The most important part of any game and simulation is reviewing the lessons learned from the play. This is where the participants' experiences are transformed into education. Merely, "playing a game" in a classroom

is not sufficient and there must be a review that reinforces the exercise's goals. The debriefing can be the most difficult aspect of any game, since it is quite possible that things occurred during the game are not anticipated. The game leader must be aware of everything that is happening during the game, even the unplanned events, and be able to translate all the activity into a set of lessons learned. If there are multiple observers, each can add his/her observations to the debriefing and thus enrich the experience. The debriefing session is characterized by student participation and is the actual goal of any game, getting students involved in and responsible for their own education. It may be useful for the instructor asks questions like: How "real" was the exercise?; How did the exercise parallel or different from the real world?; What was learned from the exercise?; and What would happen, if the exercise had been conducted differently? During the debriefing sessions, students take theoretical concepts and connect them with the exercise. Basic concepts that are practiced and learned, while playing the game become more meaningful when the students are able to link them with their own experiences. Practice and experience, as basic elements of games, help students reinforce material learned. As students undertake active, effective and systematic information gathering, theories no longer become abstract concepts that are memorized.

Conclusions

This paper provides a model for developing simulations and games. These are active exercises that can be used to improve teaching effectiveness through promotion of active learning. Effective information gathering can be followed by comprehension, application, analysis, synthesis and evaluation. All these elements contribute to an effective process of learning where cognitive thinking skills are developed and practiced. Simulations and games give students real experiences and make the concepts learned more meaningful. The debriefing sessions that follow the exercises stimulate discussion and provide a background for the analysis of real-life situations. Simulations and games have a strong impact on students, because role-playing facilitates active learning, permits the acceptance of new concepts and generates increased student interest, enthusiasm and motivation. Students' comments show simulations and games work, because the exercises can be structured and allow students to become an important element of the learning process.

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