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Charting the experiential territory

Clarifying definitions and uses of computer simulation, games, and role play

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Abstract *The literature around experiential learning is unclear regarding the similarities and differences among simulation, games, and role play. In order to appropriately evaluate instructional processes, definitional clarity is necessary. In this article, we provide a definitional foundation and classification scheme for the topics of computer simulation, role play, and games. The educational and training outcomes of each are discussed, providing readers the means to determine for themselves, the pedagogical appropriateness of simulation, games, or role play to a given situation.*

Introduction

This article rises out of frustration, the frustration from reading a wide variety of papers each using words like simulation, games, role playing, gaming, and symbolic modeling either without definition or inconsistency from one work to another. In part, our intention in this paper is to provide a classification scheme, a taxonomy and nomenclature for simulation. We believe this is necessary for the purposes of assessment and evaluation of instructional processes. To do this, we focus our discussion on the uses of simulation as an experiential methodology for education and training.

In the literature, authors waver on their definitions of role playing, gaming, and computer simulation. Simulation modeling is a well-established technique that duplicates the "features, appearance, and characteristics" of a real business or management system through an iconic or symbolic model (Render and Stair, 1997, p. 692). Many tend to place role playing and gaming within the context of some kind of general definition of simulation (for comprehensive examples of this problem, see Butler *et al.*, 1988; Cherryholmes, 1966; Pierfy, 1977; Zuckerman and Horn, 1973). On the contrary, we argue that simulation cannot be viewed as a collection of methodologies for experiential learning environments if we expect to be able to effectively assess their value. Therefore, role playing, gaming, and computer simulation are defined as separate activities in an effort to differentiate them for the purpose of evaluating their effectiveness as teaching methodologies.

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The basis for our arguments will be grounded in the management sciences. That is, we will view simulation as a tool to assist in decision-making, as it would be accomplished in the management of agencies and organizations. The remainder of this paper has the following organization. In the first section, we provide a discussion of experiential learning. We next discuss three types of experiential activities – computer simulation, gaming, and role play – that repeatedly fall under the general auspices of simulation. We then provide definitions of these activities and give examples from the literature that form the foundation of our discussion. Finally, we explain the importance and effectiveness of simulation in education and training.

Experiential learning activities in business and management education

Experiential learning is a participatory method of learning that involves a variety of a person's mental capabilities. It exists when a learner processes information in an active and immersive learning environment.

Kolb (1984, p. 236) explained that participants involved in an experiential learning exercise "must be able to involve themselves fully, openly, and without bias in new experiences; they must be able to observe and reflect on these experiences from many perspectives; they must be able to create concepts that integrate their observations into logically sound theories; and they must be able to use these theories to make decisions and solve problems".

A recent empirical study has shown that experiential learning activities can increase a learner's dynamic knowledge (Feinstein, 2001). Findings demonstrate that experiential learning increases learners' capacity to evoke higher-order cognitive abilities in terms of problem-solving skills and judgment.

Grappling with the effective application of pedagogy that includes experiential learning activities, several authors have quoted an ancient statement by Confucius (Kolb *et al.*, 1974; Specht and Sandlin, 1991):

> I hear and I forget
> I see and I remember
> I do and I understand.

Specht and Sandlin (1991, p. 196) believe that "experiential learning focuses on 'doing' in addition to the 'hearing' and 'seeing' that occur in traditional lecture class". They also argue that experiential learning is a structured activity in which material and principles that are encountered are integrated and applied to new situations.

There are many types of learning activities currently being used to train or educate students about the theories, principles, and processes of business and management. Of these, three are closely tied types that allow for the immersion of students in a game-like environment and rely heavily on experiential activities as a mode of instruction: role playing, gaming, and computer simulation. However, many authors group these activities under the general umbrella of simulation. And, as stated earlier, they utilize the term simulation without definition or are inconsistent in its application.

Foundation for definitions

The basis for the definition of simulation must begin with its foundation, the model. We use the classic definition of model as a representation of the reality it is constructed to depict. The representation of reality is most often seen as the modeling of a real world phenomenon usually termed "the system". We recognize that models can take a variety of forms. We intend for our definitions to be equally applicable to verbal models, graphic models, physical or iconic models, and symbolic or mathematical models.

Accepting that the model is a representation of reality, simulation can be defined then as the behavior of the model. With a foundation being built in the management sciences, the model will have entities that can be described as a performance measure, decision variables (control variables), parameters (uncontrolled variables), and functional expressions describing the interaction of system components that limit the values of the decision variables (constraints). The behavior we observe, that is defined as a simulation, is the change in any of these entities as one or more of them are allowed to assume different values or constructs. Often, time is involved as we allow different values or attributes to be assumed over a change in time.

The above representation is most often illustrated through the use of mathematical symbolism and mathematical models. However, this representation is equally applicable to other models as well. In mathematical models, because we are creating the model with variables, it is quite clear how value changes can occur and the observation of system behavior is obvious. However, in the case of a verbal, physical, or graphic model describing a system, we need to take a different approach to describing its behavior.

If we think of the verbal model as a set of statements describing a system, then the observed behavior of this model would be to see if those statements would change as the system moves either over time or space. It should be clear that words would be used to describe the system elements that in the mathematical model would be described via symbols. So, as the system changes over time, different words are used to describe the constructs and variables.

A graphic model using artistic elements to depict a system could be redrawn as the system changes. Visible differences would then be described as the change occurred. These differences could be depicted using color differences, size differences, shape differences, etc.

A physical model could be observed as it was put through its intended use. One could think of an airframe in a wind tunnel for example. Changes in performance of the airframe would be recorded as the behavior of this model.

With these constructs in mind as our basic definitions, we are now ready to tackle defining the terms role playing, games, and computer simulation. Our basic belief, and one that we will use in the following definitions, is that each is a form of simulation as it has just been defined. We will not use the word simulation unless we intend the totality of role playing, gaming and computer simulation as we have just presented.

Role playing

Role playing allows participants to immerse themselves in a learning environment by acting out the role of a character or part in a particular situation. The participant follows a set of rules that defines the situation and then interacts with others who are also role playing. This learning activity allows participants to get an in-depth understanding of many of the social interactions that arise when evaluating or solving a problem. An example of a role play was described by the director of Steps Role Play:

> A company briefs on its difficulties, such as poor internal communication, and we can act them out in the form of a simple play ... The client is then forced to confront the trouble (Curtis, 2000).

For more examples of role play, see Thorsteinson and Balzer (1999) and Yukl *et al.* (1999).

Problems with role playing include the fact that participants receive feedback from other participants in the role playing, regardless of whether or not this feedback is congruent with outcomes that would exist in the real world. Concurrently, enforcement of rules of the role playing can be extremely subjective because the dynamic component of the learning environment relies on other participants' interactions. These other participants can be novices in the subject matter, or poorly equipped to respond in a manner that is congruent with the objectives of the learning activity. Thus, for role play to be maximally effective, it is incumbent on the instructor to ensure that participants all possess some pre-determined, baseline level of understanding and proficiency. Inherent in role playing is some measure of interpersonal improvisation. Such improvisation, not unlike the improvisations that are part of a manager's daily life, requires that participants attend to all forms of feedback available in the environment (Corsun and Enz, 1995). The sources of these data in the context of a role play may emanate from the self in the form of emotional, cognitive, and physiological reactions to the context, the activity around which the role play is structured, or to other participants. These data may also derive directly from other participants as one observes the verbal and non-verbal cues others provide. Thus, we contend that regardless of what the explicit purpose of a role play may be – whether negotiation, promoting cross-cultural understanding, or some other stated, usually skill-centered objective – implicit in any role play is the secondary purpose of interpersonal skill-building.

Generally, because most role play is designed to address skills that require interpersonal interaction, it is the appropriate choice from among the different simulation types when the primary learning objectives involve such skills. Since simulation provides an opportunity for the learner to "do the thing" in a relatively safe environment, when the thing is principally interpersonal, it is logical that the pedagogical tool be similar in nature.

Games and gaming

Gaming consists of "interactions among players placed in a prescribed setting and constrained by a set of rules and procedures" (Hsu, 1989, p. 409). This interaction that excludes acting, can also include "competition, cooperation, conflict, even collusion" (Hsu, 1989, p. 409). Games of this type are thought to have originated in China around 3000 BC from Wei Chi, the precursor of chess (Hsu, 1989) or from Wie-Hai, a Hindu game (Wilson, 1968). These games were militarily oriented. Winning occurred when one's opponent was defeated through the eradication of his or her armies.

The American Management Association created one of the first business management games in 1956 (Miles *et al.*, 1986). Current management games are typically centered on an organization, or a functional area of that organization, within a particular industry. Teams are usually formed and are provided with financial, demographic, and other related information on their company. These teams then make managerial decisions on topics such as allocation of resources, marketing strategies, research and development, fee and price structures. These games are typically turn-based or round-based, where teams first make a set of decisions after reviewing preliminary external or competitor variables. Next, the decisions are used to adjust these variables and to evaluate teams' decisions. A new round, based on the adjusted variables, is conducted until a new set of decisions has been made. The process normally repeats itself for a predetermined number of rounds. Teams compete against each other for a limited amount of resources, against a facilitator who is manipulating the external variables, or a combination of the two. Outcomes are typically rewarded for maximizing profitability and creating innovative managerial strategies. Business and management games of this nature have been around for decades (for an in-depth review of these games and their effectiveness as instructional systems, see Greenlaw and Wyman, 1973; Horn and Cleaves, 1980; Wolfe, 1985, 1993).

The greatest weakness of these games is their inability to provide the learner with a dynamic environment. Time, in essence, stands still while the teams are implementing their decision strategies. Then, time jumps forward at the end of each round. Although players are under a time deadline and decision time might be included in the adjustment of variables, players cannot observe the impact or interactions of their decisions with external and competitor variables until the round is complete. Further, creating what-if scenarios is extremely difficult. Decisions are made based upon what happened in the last round, not what is happening at the time.

There is an element of role playing in management games (at least for those involving team play) in that team members interact with one another in producing decisions. By necessity, team members must apply their interpersonal skills in determining courses of action. As a function of their interpersonal elements, role play and team games provide learning opportunities at a minimum of two levels, content and process. The benefits of players' application and practice of interpersonal skills, whether in role play or games, are maximized, possibly even realized, only when the instructor makes this secondary goal explicit when processing the "play". In essence, if the post-play discussion is focused only around content, and process is ignored, a learning opportunity is squandered.

Since management games are principally strategic in nature – typically involving decisions regarding the organized deployment of resources to meet some market need or opportunity in the face of competition – they are an appropriate pedagogical choice when the primary learning objectives involve such decision making. When an instructor has the secondary goal of having people work on their team skills in reaching such decisions, games are the appropriate venue. It is the imperfection and imprecision arising from the persons and personalities present in the gaming environment that makes them somewhat reflective of the decision-making environments real organizations represent. When the goal is to understand the operation of the system, absent its human elements, computer simulation is the most appropriate choice.

Computer simulation

Using a symbolic model, computer simulation attempts to replicate the characteristics of the system through the use of mathematics or simple object representations. The interaction of the functional entities of the system is described with symbols, words, and mathematics. An excellent book on computer simulation modeling is the recent publication by Law and Kelton (2000). An example of a mathematical technique used to mimic a probabilistic process within computer simulation is the Monte Carlo method (for a discussion of Monte Carlo simulation and some of its applications, see Atkinson *et al.*, 1997; Field *et al.*, 1997; Sheel, 1995). Some symbolic simulations also utilize alphanumeric data for representation (Race and Brook, 1980).

Computer simulation can be further defined by describing its underlying model as discrete event, continuous event, or combined event. A discrete event computer simulation uses "blocks of time during which no changes to the system state occur" to simulate variables within the model (McHaney and White, 1998, p. 193). This type of computer simulation uses the arrival of entities or the completion of an event as a cue to adjust the computer simulation time clock. Each movement in time takes place instantaneously, or "in discrete steps" (McHaney and White, 1998, p. 193). An example of a discrete event computer simulation is to observe the behavior of a model of the customer flow in a quick service restaurant. Events such as the arrival of a customer, the completion of cooking a hamburger, and the exiting of a customer from the restaurant all allow for the adjustment of the time clock and the manipulation of variables that are affected by each event.

Continuous event computer simulations allow variables within the model to be continuously changing. These models are "based on a defined relationship for the state of the system over time" (Pegden *et al.*, 1995, p. 433). An example of a continuous event computer simulation is to observe the behavior of the model of the oil temperature in a deep fryer at a quick service restaurant.

Suppose a restaurant manager wanted to determine how many deep fryers were needed to perform optimally during the lunch rush. One would first need to determine the maximum capacity of the current fryers. To do this, a manager could first analyze the types and intervals of frozen food being dropped into and removed from the fry oil and their effect on oil temperature. This analysis is useful because as each food item is dropped into and removed from the deep fryer, its associated temperature, size and density affects the oil temperature. The collection of observational data on the usage of the deep fryers could be used to determine the effect of each food item on the temperature of the fry oil. Then, a model could be created representing the fry oil temperature fluctuation during the lunch rush. A determination could be made to see if the fry oil temperature were to go below a critical level for the proper cooking of a particular food item. Because it would be important to know if the oil temperature ever goes below a critical level, continuous event computer simulation methods would need to be implemented.

Simulators vs simulation

Several authors have made a distinction between simulation and simulators. Hays and Singer (1989, p. 13) believe that "a simulator is a complex device that provides a highly realistic simulation of the operational situation and provides a situation adequate for practicing and maintaining previously acquired skills", whereas simulation is the act of immersing the trainee in the simulator. Morris and Thomas (1976, p. 66), assert that simulators are "the media through which a trainee may experience the simulation" and simulation is "the ongoing representation of certain features of a real situation to achieve some specific training objective".

Hays and Singer (1989) and Kinkade and Wheaton (1972), refer to simulators as training devices. These devices are either part-task trainers or whole-task trainers. Part-task trainers "provide instruction on a small segment of the total operational task, called a sub-task". Whole-task trainers "are used to teach the task as an integrated unit" (Hays and Singer, 1989, p. 13). Iconic models are sometimes called simulators because of their visual, auditory, and kinesthetic representations of a real system. An example of an iconic model is a flight simulator. Typically, these iconic models "are used primarily for training purposes" (Pegden *et al.*, 1995, p. 5). They may, however, be used for other purposes. For example, some firms, rather than employing random drug or alcohol testing, use computer or mechanical simulators as behavioral tests of workers' fitness to perform their jobs (Jex, 1987).

A notable difference between computer simulations and either role play or team games, is the absence of an interpersonal element in computer simulations. In contrast to these two other types of experiential learning activities, computer simulation is primarily focused on content. The interpersonal learning associated with a secondary, process focus is typically absent.

The importance and effectiveness of simulation in education and training

Education vs training

Today, simulation methods are used more for training personnel than educating them. Typically, education places the emphasis of learning on factual information whereas training places the emphasis on "the practical, on decision making, on communication skills, and on doing the job" – dynamic information (Jones, 1995, p. 44). Jones (1995) stated that "[a] general distinction is that training is particularly concerned with the process, whereas education in more concerned with the 'product'". One of the challenges of using simulation methods for training is in the evaluation of the process. Product learning tends to be easier to evaluate because it "tends to be clearly defined and measurable so that success and failure can be reflected in statistics" (Jones, 1995, p. 45). Corsun (2000, p. 10) distinguished between training and education by thinking about scope:

> Training is targeted at the accomplishment of a finite set of tasks, duties, and responsibilities associated with a given organizational role. The knowledge, skills, and abilities required to be a successful role-performer are transferred from the trainer to the trainee by a variety of means. In contrast, education is more general and is not targeted at successful organizational role performance. Education goes beyond knowledge acquisition … developing critical thinking skills, the ability to formulate good questions, and the wherewithal to know how to find answers.

Although some authors in the 1970s contended "much evidence has accrued to suggest that elements of simulation play can be transferred or adapted and used consciously as an approach to learning – both in school and in adult learning" (Taylor and Walford, 1978, p. 2), most researchers were not convinced. These authors explained that many researchers believed it was difficult to evaluate a simulation model's effectiveness as a learning tool.

Cognitive implications

Cognitive research over the last few years has begun to reinforce the early indications of the educational benefits of simulation. Researchers believe that they are beginning to understand how the mind stores, retrieves, and utilizes information (McTear, 1988; Wagman, 1993, 1995). Researchers in instructional simulation have thought that this method of learning was effective because "people learn to act by acting; they learn to live by living; they learn to do, by doing; and they learn to understand their 'spirits' when they reflect on their interactive activity" (Hyman, 1978, p. 153).

Much of case-based reasoning is grounded in this principle. In the view of Bruner (1960) and Schank (1990), a human mind learns through the development of stories. A story is a sequential order of events, occurrences, or interpretations that are taken in and stored, retrieved, and possibly even "told". Schank believed that people take these stories and develop a script on which to base their actions. People are constantly trying to apply these scripts to new situations and evaluate their similarities. Humans' ability to create, store, retrieve, and modify these scripts to a new situation can be viewed as intelligence. Although the aim of the simulation researcher is not to develop intelligence per se, by providing managers with an opportunity to develop these situated scripts, learners could become better equipped to deal with situations in which similar events occur.

Motivation

Other benefits to utilizing simulation techniques include learner motivation (Hannafin and Peck, 1988; Loftus and Loftus, 1983; Malone, 1980; Towne *et al.*, 1993). Motivational interest in simulation stems from the game-like atmosphere that it presents, its competitive components for trying to find the right answer, its ability to immerse the user's mind, and its "contrast with traditional procedures for teaching and learning" (Hyman, 1978, p. 154). Reich and DeFranco (1994, p. 13) also state that "the tactics of delivery style and goal oriented activities form the basis for a teacher's success in being able to interest students in the topic, then guide them through meaningful exercises that lead to a competent grasp of the subject". Further, simulation allows students to "practice their skills of decision making and skills of planning alternative strategies" and evaluate the outcome of their decisions (Hyman, 1978, p. 155).

Loftus and Loftus (1983) state that simulation also allows for a variable reinforcement ratio (a variable ratio changes the time between, or number of, responses for a learner to acquire a reinforcement). This reinforcement technique "typically produces the highest and steadiest rates of responding" (Driscoll, 1994, p. 48).

Finally, many authors have contended that an effective learning environment is one that allows learners to explore and learn independently (Collins and Brown, 1988; Shute *et al.*, 1989; White and Horowitz, 1987). Simulation seems to fall into this category in particular because of its inherent ability to allow learners to evaluate and manipulate an object system.

Situated learning

Research into situated learning, a philosophy that combines cognitive theories with situated activity, shows that people might view knowledge as a "relation between an individual and a social or physical situation rather than as a property of an individual" (Greeno, 1989, p. 286).

Some researchers contend that knowledge is "situation specific and context dependent" (Kintsch, 1988, p. 165). It has also been stated that "researchers have argued against the existence of general context-free cognitive skills and for learning in highly contextualized ways" (Driscoll, 1994, p. 163). These concepts also parallel the hermeneutical position: knowledge is not innate; it is not tied to a particular object to which we all have access; it lies in our interaction with these objects. Arguably, with regard to knowledge pertaining to the interpersonal, knowledge lies in the interaction between individuals.

A more effective instructional technique might be to allow learners to gain dynamic knowledge through their own discovery process in a simulated environment rather than just by analyzing inert factual data. By allowing learning to take place through practice, learners can be placed in a simulation where they acquire dynamic knowledge through object and situational interaction.

Conclusion

Experiential learning involves immersing learners in an environment in which they actively participate in acquiring knowledge. Computer simulation is an experiential learning activity that allows learners to visualize situations and see the results of manipulating variables in a dynamic environment. This type of learning environment is advantageous over role play in that the level of subjectivity in instruction and assessment can be greatly reduced. Further, simulation can provide a dynamic visual environment that cannot be duplicated in typical turn-based strategies of gaming.

The above advantages notwithstanding, computer simulation is not an educational panacea. When the desired learning outcomes include the development of interpersonal and/or team skills, computer simulation is probably not the best experiential learning tool for the job. The environmental dynamism one sacrifices in choosing management games over computer simulation may be compensated for, at least in some measure, by the interpersonal elements associated with team-based games. Thus, we are not arguing for the inherent superiority of computer simulation. Such a view is too narrow. Rather, following Gist (1997), we propose that pedagogical choices – in this case the choice one makes from among role playing, games, and computer simulation – should be driven by the desired learning outcomes. Although on its face this notion seems obvious, it bears mention. In our experience, teachers and trainers often make pedagogical choices based upon criteria other than this most important one (e.g. ease of use or their own comfort with the technique/modality). Finally, it is dangerous to assume that what appears obvious to one is obvious to all. When one hears the phrase "that is common sense", one should wonder "common to whom?".

Although simulation models need to imitate situations in such a manner that a learner can gain insight into the interaction of variables within that system, these situations do not need to be exact replicates. In fact, lower-fidelity simulation models can actually assist novice managers by focusing their attention on important variables.

Using experiential methods in education and training has many benefits beyond traditional forms of instruction. Student motivation has been shown to be a great asset when using simulation, which increases students' interest and participation in learning activities. Recent research in cognitive science and situated learning further supports the benefits of immersing learners in interactive environments that replicate situations that they might encounter on the job.

This article contributes to the understanding and appropriate use of experiential learning activities in two important ways. First, by clearly defining and differentiating among computer simulation, role play, and games, we have facilitated communication among users of these experiential learning activities through a common language. Second, we delineated the benefits and drawbacks of each type of activity, thereby enabling users of these activities to make pedagogical choices consistent with desired learning outcomes. These contributions should serve to enhance the benefit academics and practitioners derive from using computer simulation, role play, and games in management classrooms and organizations.

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