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Games And Simulations for Training: From Group Activities to Virtual Reality

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DEFINITIONS

There has always been controversy, confusion, excitement, and passionately held opinions around the topic of games and simulations. Many view games as being devoid of content and structured only for entertainment, while flight simulators are viewed as essential training tools for airline pilots. Others say that video game simulations are useless non constructive forms of entertainment, and that games especially are detrimental to youth and a complete waste of time for an adult population (Bandura, Ross, & Ross, 1961; Barmazel, 1993; Griffiths, 1999; Herz, 1997). While others claim that only through games and simulations will we ever be able to reach the engagement, learning, and performance levels educators and trainers have been seeking for centuries, thus targeting games and simulations as the latest panacea for instruction and performance interventions (Crawford, 1984; Gee, 2003; Gibbons, Fairweather, Anderson, & Merrill; Rollings, 2000; Thiagarajan, 1994).

For there to be such wide spread opinions, there must also be some element of truth feeding each point of view, and this makes it particularly difficult for the human performance technologist to decide if and when to use a simulation or game, and to determine which of the many modes of delivery would be appropriate to meet their training goals in specific contexts. The purpose of this chapter is to assist in the selection making process. We plan to do this by first addressing the concept definitions of games and simulations, then introduce selected case studies of implementation, followed by a focus on strategies for development. By laying out these options, development variables, and examples of successful use, we trust that you will be able to determine the potential of games and simulations for meeting your performance intervention needs and determine if the return on the development and implementation investment will balance out to the positive side of the equation.

CLASSIC PERCEPTIONS OF GAMES

The first thing that usually pops into someone's mind when the word *game* is mentioned is some activity that is strictly non work related, is done by choice, is 'fun and entertaining,' and will not require any recall of the game play for future non game use. A trainer implementing a game as an intervention must immediately confront these perceptions by addressing the fact that a game is being used for something work related, there is no choice but to play, and that there is an expectation to remember and reflect upon the game play. The aspects of the game being fun and entertaining may still be the case, but just what 'fun' is and what 'entertaining' is usually requires some deeper analysis and redefining on the part of both the trainer and trainee. Both fun and entertainment are primary motivators that the trainer may use to increase the engagement and focus on the topic at hand.

OUTCOMES, ASPECTS, AND CHARACTERISTICS OF GAMES

To sort out just what a game is requires delineating the difference between what happens during an activity or game and what outcomes resulted from the experience with that game. For instance, fun, entertainment, learning, and improved competency are all ***outcomes*** of a game. Game elements such as the specific tasks, consequences, and available interactions are ***aspects*** of a game. There are specific combinations of these aspects that are targeted at certain outcomes, and these become ***characteristics*** that define games from other forms of solutions. Six characteristic are present in all games:

1. Challenges: goals and tasks.
2. Rules: that govern how the game works.
3. Interaction: by the user with aspects of the game.
4. Contrivance: modifying realism to benefit game play.
5. Obstacles: elements of the game encountered.
6. Closure: an end to the game.

Outcomes

Discussions surrounding needs within an organization, performance problems, lack of information, or even too much information will begin to frame desired *outcomes* that the selected intervention is to generate. An outcome is pivotal to establish first because it will be the yardstick for success of any decisions made in selection and implementation of the intervention, be it a game, simulation, or direct instruction. Games may achieve many desired *outcomes*, such as:

- Increased skill.
- Understanding the implementation of a process.
- Deeper understanding of relationships and concepts.
- Awareness of cross-training needs.

Aspects And Characteristics

The elements of the game from the arrangement of people in a group, to game board arrangement, to virtual rooms, and avatars that are placed in virtual space are all *aspects* of a game. The *aspects* are what a player interacts with to achieve the optional or required tasks that a player may perform while engaged in game play. These *aspects* are the variables of the game designer who manipulates them to achieve the desired *outcomes*. All games will have aspects with some degree of challenges, rules, interaction, contrivance, obstacles, and closure.

Challenges

If there is no *challenge* to a player, then boredom ensues and little benefit is reaped from the experience. Presenting tasks where players must compete with each other or work together to overcome obstacles in their path may present engaging *challenges*. Drawing upon previous knowledge and skills, the ability to seek and find new information or solutions, or to form new relationships and strategies to solve problems may all be *challenges* that make a game engaging.

Rules

The *rules* of the game also create a *challenge* in a game. In a role play game, a rule may be 'to not speak until you hear a direct question.' or on a board game 'you may only move the number of spaces shown on the dice,' and in a virtual game 'you may only get into a room after you have completed a specific task.' The *rules* of a game work in harmony with the tasks to achieve specific *outcomes*. In a team based game a facilitator may state *rules* at the beginning of an activity, but depending on how the game is progressing, the facilitator may also change or add *rules*. When facilitators are absent, then the *rules* must be more rigid and embedded in the *instructions* that accompany a game, or within the artificial intelligence (AI) of a virtual game.

Interaction

If a player does not *interact* with a game, then they are not playing, they are passive observers. This does not mean that passive observation cannot be part of what a player is asked to do during game play, but if there is no *interaction* through dialog and decision making, then there is no game play. What makes a game engaging is the *interaction* with the *aspects* of the game.

Often it is the need for more and more *interactive aspects* of a game that cause game designers and implementers to stretch their resources and skills. Similar to *challenges* in a game, if the *interactivity* for a player is too low, then boredom ensues.

Contrivance

If you could really fail, offend someone, or lose your job, or even get physically hurt, then the game would not be fun nor would it be a constructive activity. In a game there is a suspension of significant negative consequences to game play such that new doorways may be opened for people to explore. To this extent any game has a certain amount of *contrivance* to assure the players freedom to try things that they may not do otherwise, or to just have fun interacting with critical elements. However, for any game to be an effective intervention there needs to be some correspondence however fleeting to the player's real day to day existence.

Obstacles

In order for there to be *challenges*, there need to be *obstacles* along the game play path. These obstacles may be anything or anyone that must be dealt with in order to proceed through the game. They could be psychological in nature where a person must overcome a self efficacy issue relating to communication with authority figures, or it might involve learning the operation of a piece of equipment, or in virtual military training scenario, to decide if a game character encountered must be terminated somehow. In training scenarios, each obstacle represents a decision point for the player on how to proceed to the end goal. Strategic placement of obstacles along a game play path is a key strategic design decision of the game designer.

Closure

There is always a temporal aspect to a game that places boundaries around the beginning and ending of a game. If the end time is reached prior to the player completing all the objectives, or if someone 'wins' before the end of the game, then the game play is over. Within these boundaries is the aspect of *in game* play. *Outside game* activities focuses on what occurs before or after *in game* play. Closure may come to the *in game* play, but *outside game* activities must still progress to resolution

and understanding of what happened during game play. The degree of contrivance of the game must then be extrapolated to the real day to day existence of each player. The meaning of why the activity was carried out must then be discussed so that the desired outcomes and a true sense of closure and understanding can be achieved.

WHAT ARE SIMULATIONS (SIMS)?

Simulations began when people started to role play events that occur in real life. Whenever one proceeds into an activity that somehow mirrors a process, place, or event, a simulation strategy is being used to some extent. The modality of a *sim* may extend from arrangements of people to sophisticated game like virtual spaces, and may even utilize both modalities in a blended learning context called *mixed reality*.

Simulations are receiving special attention because of the computer capabilities to create realistic models of people, places, and things. This makes it possible to use simulation strategies in a virtual mode to mirror more situations than could have been possible prior to this capability, and to even consider using virtual space to mirror interpersonal interactions and decision making. Like games, all cases of *sims* will be directed toward particular outcomes and will have certain aspects that are unique to a specific context. All will have varying degrees of the common characteristics and players will engage in interactions and activities similar to games. However, there are subtle, yet significant differences found in the targeted outcomes and structural characteristics of a simulation compared to a game.

Outcomes

Outcomes are one of the primary discriminators between *games* and *sims*. Fun and entertainment may be important outcomes of a *game*, but they are not primary outcomes of a *simulation*. How a person 'plays' a *sim* is more important than where they end up, since completion or winning is not one of the characteristics. Thus the ability of the player to make critical judgments and decisions during *sim-play* and reflect on each of them is one of the primary outcomes. Just as with *games* that are being used for training purposes, the scaffolding around a *simulation* of *outside sim activities* are just as, if not more important than the *inside sim activities*.

For example, during a role playing simulation, real emotions may surface and decisions made may cause equally strong reactions from the players. Reflection after the simulation is critical to bring out these interactions to the level of understanding desired for the targeted outcomes. Likewise, in a flight simulator the actions of the sim pilot that results in a crash may seem devastating enough to the one who caused it, but unpacking the sequence of decisions made and pointing out the good and bad ones is where the learning occurs.

Aspects: Why Not Characteristics?

Simulations are made of elements that have more relationship to real world attributes than is necessary in games. The degree of correspondence of any attribute of an element within a simulation to its counterpart in the real world is called *level of fidelity*. Attributes may have exact physical characteristics matching specific people in

actual places, for example the person in this sim actually looks like the manager 'George Smith' which is high fidelity, or they may have only metaphoric characteristics that match, for example, the person only looks slightly humanoid with a label of 'manager' which is low fidelity. In a team based activity another person would only try to emulate the interpersonal communication appropriate to the manager which is medium fidelity.

For outcomes that require high correspondence between the actions during *sim play* and the actions during actual performance, the *level of fidelity* of critical *aspects* must be high, such as with flight simulators. Conversely, when reflection of *sim play* during *outside sim activities* is more critical, then the *level of fidelity* could be lower such as with customer sales training where the strategic choices of the player within generic contexts are the focus.

Often various aspects of the *sim* have increased levels of fidelity due to the concern for maintaining user engagement and motivation. Even though this increase may not directly affect an outcome, it may increase elements of fun and entertainment necessary to keep the user on task. However, such decisions by the designer to inflate the fidelity come at a price since every step in fidelity will most likely multiply the development cost. An iterative rapid prototyping development process will assist in determining the appropriate final fidelity level of the *simulation*.

Characteristics

All *simulations* will have different weights of the following 6 *common characteristics* depending on the desired outcomes.

Challenges

Challenges in a *sim* may be game like in nature, but the focus on how one deals with each challenge will reflect more on 'success' than getting to the end of a game. Real life presents many challenges and reconfiguring these same challenges in a simulated context can engage learners to produce innovative *outcomes,* thus developing new strategies and tactics for application outside of the simulation.

Models

Simulations are based on models of reality and these models act like rules in a game. For instance 'laws of physics' dictate that an object will fall at 9.8 meters/second^2 and while training in a virtual environment if predicting when an object hits the ground is critical, then the physics model that controls the path of the object must have a high *level of fidelity*. If when it hits the ground is not a critical factor, but that it just drops, then the physics model can be lower fidelity. Similarly if a team activity is being used to simulate the cooperation necessary between departments in a specific company, then the management model of that company must be used. If the goal is to examine alternatives to cooperation strategies, then more general models may be used or even manipulated during the *sim play*.

Control

In education we speak of learner centered instruction and learner control. In both games and simulations there are player characters (PC) that refer to the people playing, and non player characters (NPC) who are either following a script or are programmed by the AI of the game or sim. The PC of the *sim* must feel they have *control* of variables within the given model or else they feel more like an NPC just acting out a script. Without *control* there are no decisions to make, so each element the PC controls is a critical design decision. The *control* may be to create or select a response to another person, to actuate a piece of equipment, or simply to move forward with a decision to engage.

Manipulation

Manipulation is more than control, it is how and to what degree you control. There are many variable aspects within a simulation and the player's choice of which ones and how they are manipulated, is a critical focus of a *sim*. One variable in a *sim* may be to negotiate with people. If an outcome of the *sim* is to create a support base for your plan of action, then you may choose to seek and find every possible person within the boundaries and negotiate their support. Other players may select specific people to negotiate with and not contact others, thus *manipulating* the variable by degree of use.

In the simulation 'Zoo Tycoon.' animal habitats are created by the PC that may have adequate food, shelter, and desired space to make content a specific animal. Manipulation of these variables are extensive, such that the PC may reduce food, space, and even shelter to find at what point the animal dies. This is important knowledge that may only be found in a simulation where the underlying model allows authentic consequences from such manipulations.

Authenticity

Just as we spoke of having individual elements having *levels of fidelity*, the setting, actions, and relationships, of these elements may be described as having *levels of authenticity*. Simulations must have authentic variables, actions, and consequences for sim-play, but the *levels-of-authenticity* in all areas may vary. For instance if an outcome is to appreciate the variety of skills that each team member has, these team members could act out the select roles as different fish or crustaceans where each player must learn about the other's capabilities and assign roles for their team. In this case the contextual authenticity may be low, but the variable of variety of skills, combined with the player actions of selection, could match real strategies and tactics that engage the desired learning from the resulting consequences. Toward the other end of the scale, such as with flight simulators, not only must the physics models, the visual, and auditory input be authentic, but also the kinesthetic input of gravity and momentum variations must be of very high fidelity, thus placing this with a high *level –of authenticity*.

Consequences

Consequences are the result of the control and manipulation in a simulation by the PC within the operational limitations of the existing model. They also are the result of *outside sim activities* allowing reflection and learning. Consequences for high risk topics such as military training and in medical contexts may be immediate and bring an end to the simulation, for example, someone dies in the sim. In other cases, the consequences may not be as apparent until during debriefing after *sim play*, when the results of the player decisions are posted and the composite of all player actions result in a major *consequence*. The feedback to the player during a sim is a design variable that can greatly affect the degree of learning from a sim. The designer may provide help, coaching, warnings, and so on as the simulation proceeds, but the goal in a sim is not to avoid failure but to understand decisions and resulting *consequences*. Thus, iterative simulation modules following reflection periods are often used for complex scenarios and tasks.

CASE STUDIES

Following are brief examples of interventions using a variety of games and simulations. We will begin using the term “mode” when distinguishing between the form of delivery of these interventions. Face-to-face team based, computer driven virtual, or a combination of actual face-to-face mixed with computerized information in a mixed-reality delivery, are all different modes. Our intent is that the following case studies will provide some concrete examples of how specific outcomes have been met using these modes of interventions.

Training On Insurance Benefits For Help Line Trainees

The Need

In a large mid western insurance company that receives hundreds of phone inquiries daily for clarifications and handling of claims and claim information, a training need was identified to improve both the content knowledge about the benefits offered and also to provide clear accurate information to policy holders. Because of the relatively boring content, the need for understanding at a significant depth, and the desire to increase team effectiveness, a group game activity was selected as the intervention mode to use on a cohort of new trainees.

Face To Face Team Based Game Activities

Part of any group dynamic are major hurtles to overcome such as any group member’s fear of failing in front of peers and supervisors. This has an effect of limiting innovation, creative logical reasoning, and in general allowing only ‘safe’ answers to surface. Fears of saying something stupid has the effect of squelching team interaction and sharing because even if one person does know an answer to something, they may not get a chance to share it if no one else feels confident enough to ask. Efficiency of group management and finding ways to cover massive amounts of content such as that in a complete listing of insurance benefits was a major concern with this type of intervention strategy. In this case there was a requirement to bring these trainees to a

significant depth of understanding of benefits, to find information quickly and respond clearly to inquiries, and to achieve an accuracy level similar to an expert response.

Prior to the activities everyone was asked to read the primary information source on the benefits and become as familiar as possible with the contents. This brought the entry level of everyone at least up to the 'familiarity with content' level. You will note that the emphasis of these activities and 'games' is to keep the learner active at all times with some level of cognitive processing through the introduction of frequent small challenges. That is why there are many short tasks and team interactions that keep things constantly moving. Following are three activities out of six that followed each other in rapid succession.

Activity: Open Book. To provide an orientation focus each participant is asked to review the benefits for 5 minutes, then write 10 questions on separate index cards for 10 minutes. The group then breaks into teams and each set of questions is collected from one team and given to another. During the next 10 minutes the team selects the 5 best questions and discards poorly worded ones or anything redundant or unclear. During the next 10 minutes questions prepared earlier are read and team members can gain points for their team if they respond correctly. The highest scoring team wins and gains applause from the rest of the group. Note: this activity in no way requires that anyone ask a stupid question or even fail, but instead deep analysis and evaluation of the questions allow for confirmation that in-fact someone in every group could generate good questions. To reinforce teamwork, the team wins, but not any individual.
Activity: Q & A. Next the focus is on mastery of the content by asking questions again, but specifically those that are confusing or hard to understand. The participants are asked to write two questions that relate to the confusing topic and then exchange them with other participants who then do the same again. Random selection of participants allows them to read the questions they hold, and if they have the option of changing the question, but no one but they know it. The group receives accurate answers in response to these questions during the next 20 minutes. The last two minutes are devoted to reflection on the most important personal learning this exercise fostered and these are mixed up and a few of them read. Note: there is no consequence for asking "stupid questions" and no individual can be singled out, yet the most difficult portions of the benefit content are being analyzed by the entire group, and also personal reflection is shared.

Activity: Best Answers. Next the focus is on application and evaluation of the knowledge acquired so far. Participants have 5 minutes to individually respond to an open ended question about benefits. They form groups and then the answers from one group are given to another group for analysis. Before the answers are collected though, each participant puts a code number on their response. The group then discusses and selects the best response from their group. The 'best answers' are read, discussed and the code number is shared so that the person who wrote it receives applause. This is repeated for another open-ended question. And then the teams write their own open-ended questions and participants from other teams respond with answers. Note: a simple individual code protects all participants from exposure to failure and 'stupid'

questions or responses. The teams work together on problem solving, and the activity ends with team to team competition with very authentic challenges.

This mode of game and simulation depends heavily on a facilitator's skill to keep things moving, to foster a collaborative exchange among groups, and to capitalize on the game-like exercises to reduce stress and anxiety with the difficult content. This mode also allows for the most variation and accommodation to individual responses of the participants during the game experience than any other mode, and when individual responses must be judged for innovation and also accuracy, the facilitator has the opportunity to do so. Training facilitators and preparing detailed scripts are necessary if this mode is to be disseminated across large numbers of employee training (Thiagarajan, 1994, 2004).

Pre And Post Test Simulations For Pharmaceutical Sales

The Need

The sales department in this company was developing a new sales methodology that it was going to unveil to its sales force during the annual sales conference. This new methodology was drastically different than the current sales model and the company wanted to gain an understanding of how well the sales force could perform using this new model before it was taught to them and afterward. Also, the sales force was widely distributed over a large area and there was no time to conduct the assessment during the sales conference.

The solution was to incorporate the mode of an online sales simulation where each salesperson could engage using their own personal computer. It was anticipated that this would be more effective than a multiple choice test. The first simulation that the sales force completed was a few weeks before the sales conference where the new methodology would be introduced.

Pre- & Post-test Sims

In the pre test simulation, the salesperson interacted with a receptionist, nurse, and doctor at the doctor's office. The goal was to build good sales relationships with each of these individuals and investigate the environment of the office to help build these relationships. Each salesperson completed the simulation by making decisions that reflected their usual method of working with individuals in the doctor's office. Data on their performance were collected through an online learning management system and reported back to the company management.

After the sales force attended the conference and learned about the new selling methodology, they were instructed to complete a second simulation, or post test, in which they made a virtual visit to the doctor's office a second time to build relationships with the receptionist, nurse, and doctor. The pre and post test simulations where identical in their objectives, but the content differed between them.

Results

The company management was able to see how the sales force performed using the new methodology the sales force had been taught at the conference. The scoring showed that the sales force significantly improved in their performance from the pre test to the post test by applying the new methodology. In areas where the sales force did not perform well, remediation was given to help improve performance and reinforce the new methodology.

Algorithmic Strategy Simulation For Resource Management

The Need

A company that wanted to train its management on effective resource allocation had several field staff and customers to which it could apply time, training, materials, incentives, and other resources. The company used a model that reflected optimal resource management, and used this as the basis for the simulation. Strategy simulations that use algorithms to simulate real world processes have been used for years in the business community to better understand and train managers to perform well, so the mode of a computer driven simulation was selected for this intervention.

A Simulation Blended With E Learning

Because several hundred calculations were required for each action in the simulation, the company decided to develop a computer based strategy simulation that could effectively process the data. Instead of being a distributed online simulation, this simulation was built to be used in conjunction with an instructor led course on resource management. At the beginning of the course, the participants where asked to use the simulation and allocate resources to staff and customers for four simulated financial quarters. The effects of their resource management appeared in the form of product market share in the simulation. After completing the first four financial quarters, most of the participants saw a decrease in their product's market share. The instructor's next taught the participants the principles of effective resource management, and then had the participants use the simulation again for another four quarters.

Results

Most of the participants saw a dramatic increase in their market share after applying the principle taught in the course. One group, however, did not. Upon investigation, the instructors learned that this group had cultural conflicts with the way that resources were allocated to field staff in the simulation. The fact that the simulation reflected the effects of this conflict helped the instructors to further teach this group about appropriate resource management and develop a solution to their cultural conflict with the company's methodology. Accurately simulating the resource management methodology better prepared each participant to put these principles in place in the field, saving the company time and resources.

Porting Real Data Into Virtual Space For Automobile Design And Manufacturing

The Needs

The specific outcomes of these interventions are common to most manufacturing companies, such as shortening the development period, optimizing the 'fit' of different components that integrate into one unit, provide the most productive feedback to the designers on the results of design decisions, to arrive at the most efficient process of fabrication, and to test the results of these decisions through formative evaluation. BMW has initiated efforts to integrate *Virtual Reality* (VR) tools and strategies at appropriate points along their process and integrate them among traditional tried-and-true methodologies. This *mixed reality* mode strategy has allowed many of their goals to be realized (BMW-Group, 2004).

Virtual Reality (VR) Sims

The VR mode is created for designers first through the use of 3D CAD software programs that allow them to make design decisions through a graphic interface on a computer screen. These decisions are coupled to reality by making this virtual environment mimic actual dimensions of the real world such that when a line is drawn on the screen it is measured to whatever level of scale necessary. This allows the designer to create any object at any size, and then 'size' it to fit a pre existing form by simply scaling it to a desired size. The exact dimensions of the final object are then measured for manufacturing purposes.

This process may be considered a simulation since all characteristics of a sim are present. The *challenge* is to create an object that follows the functional and formal requirements to be integrated into the gestalt of the finished automobile, and the *model* is the program that controls what you may do in this virtual environment. The designer has *control* of what is attempted and the level of *manipulation* of the critical variables is high. The *level of authenticity* is high because measurements in the VR space must match the final measurements of the real object, and the results of the designers decisions have significant *consequences* as other designers around the world attempt to integrate the object into their own process.

Results

Standardization of tools, data file formats, and telecommunication protocols have allowed BMW to create a design database available to any of the design centers around the world. This amalgamation of data is analogous to a virtual manufacturing center and has contributed to reducing the development period of a new model from 6 years in the past to just 2.5 years today (BMW-Group, 2003).

DESIGN AND DEVELOPMENT

In the broadest sense, the HPT process of analysis, design, implementation, and evaluation has direct application to what we will condense here to the analysis, design and development of any form of game or simulation intervention. Yet, as George Geis pointed out in 1986, this process is highly iterative and rarely follows a linear path, but rather describes looping recycling patterns that continually feed new information into the design process at each stage.

While in the process of designing a game, the formative feedback from upper management could indicate a miss match between the value of the need for this intervention and the investment allocated to complete it. Such information would impact the scope of each phase of the process and require rethinking each strategic decision. As development complexity increases, the need to extend patterns of iterative communication in an ever increasing spiral, from the development team, through the organization, and out to the target population, becomes more critical (Spence 2002; Toth, 1997). there is also the need to visit each center of focus of the analysis, design and development process, and flow from mega strategic decision making through the macro tactical planning, and implement through the micro operational tasks within each focus center. It is this outward expansion that must coexist with the inward decision making from mega to micro that creates the often difficult tension associated with analysis, design, and development.

Analysis Focus

An *analysis focus* centers on defining the workplace context and comparing this to ideal conditions through needs, task, and gap analysis. Such a focus might reveal several factors that are contributing to a performance problem, such as a lack of communication along organizational lines, or a lack of respect or morale among employee groups fostering the need for attitude changes among individuals or groups. It could identify different groups who need training or access to specific resources. This analysis focus should also identify the propensity for the use of innovative modes of game and simulation interventions at all levels of the organization. Not only must the development team be enthusiastic, but the spiral out through the upper management and target population must at least demonstrate acceptance of their use. The extent of the gap found between the actual and desired performance, coupled with the level of acceptance to use these modes of intervention, will correlate with the scope of the interventions prescribed during a *design focus*. There are certain specific factors that need to be quantified in this *Analysis Focus.* They are highlighted below.

Your Audience of Trainees

Audience size and distribution can have great influence on what modality is chosen for delivery. If the audience is small, less than a few hundred participants, then the developer might consider more face to face interactions, if that modality fits the need of the simulation or game. While face to face delivery often has reoccurring resource needs such as the cost of facilitators and space for training, the small size of the audience makes this modality ideal. For large audience sizes, several hundred to thousands or tens of thousands, stand alone and computer based modalities such at 2D and 3D simulations and games can be a better choice. While computer based games and simulations can have higher up front costs than face to face games and simulations, these costs are spread across a larger audience and can be less expensive than face to face training when the audience size reaches the thousands.

The distribution of the audience is another important factor. If the audience is located in a central area, where travel costs are not high, then face to face modalities can make a lot of sense. However, if the audience is highly distributed 2D and 3D

computer games and simulations can be very effective for delivery since they can be sent electronically to the participant's location via the Internet or other types of electronic delivery, decreasing travel costs.

Motivation, Knowledge, And Entry Level

Often overlooked in many training interventions, the motivation level of the audience is critical in making design and development decisions for games and simulations. Often games are used because of low motivation levels on the part of the participants as described earlier in the chapter. The lower the motivation for a given topic, the more important the audience engagement in the game or sim will be. Motivation can also help make decisions around fidelity particularly in simulations. Higher visual fidelity can be more engaging to the audience and draw them in to the experience. On the other hand, highly motivated participants may need less fidelity, as they are motivated to 'make the jump' between more symbolic representations and reality.

Another important consideration with motivation is whether or not the simulation or game is a mandated experience or not. If it is mandated, then participation is more readily assured, but if it is not mandated, then the designer should include more motivational elements to the game or sim to encourage participation. Also, mandated games and simulations can often be designed to be more challenging, since the audience will need to 'stick with it' in order to the complete the experience. Non mandated games and simulations often need to have frequent rewards for the participants to keep them engaged in the experience so that they do not leave.

Game and simulation design is highly affected by the knowledge and skill level of the audience as it pertains to the topic covered in the game or sim. Is the topic new for the average participant or does it build on existing knowledge and skills? How comfortable is the audience with the topic? Answering these questions can often help a designer decide whether face to face modalities or human facilitated electronic delivery might be more effective or if stand alone modalities might be better. Obviously, good, human facilitators can respond to participant concerns much more effectively than a programmed computer or other technology, but good facilitators can be expensive and difficult to find in large numbers. 2D and 3D computer games and simulations on the other hand can be programmed with expert responses and are easily reproduced.

Design Focus

A *design focus* centers on the definition of a plan to address any needs or gaps found while in an *analysis focus*. Gaps in employee attitude might suggest the need for consensus building, culture development, skill training, or team building; while organizational analysis might reveal the need for change management, group reorganization, process improvement, or intra communication modifications. All of these target specific *outcomes* become the driving force throughout the entire HPT process. The *design focus* must specify these outcomes in a clear and specific manner, such that they can be called in for comparison against any major strategic, tactical, or operational decision that will guide the design and development of the game or simulation intervention. In this model of design and development, the

evaluation component of the HPT process is embedded in every center of focus to specifically test conformance with the prescribed *outcomes*.

In a *design focus* the ***strategic*** question becomes '"what type of experience should we place our participants in that would allow for appropriate challenges with issues, interactions with critical variables that result in meaningful consequences relative to this *outcome*?' At a more micro ***tactical*** level are the questions about further defining the experience as a game or simulation. This tactical question evaluates the importance of game characteristics such as competition like challenges and with content that is possibly more *contrived* and *fun*; versus simulation characteristics that are more *authentic* with a greater focus on *decision making* during play. Questions about the participants' need to interact through more rule-based game-like actions, or through simulated variables to achieve the desired consequences, must also be addressed in a design focus. At the most micro ***operational*** level are those decisions that tie specific aspects of the experience, such as sequence of events, encounters with specific obstacles or people, and descriptions of the play by play details within the game or simulation experience.

Outcomes Targeting Training Or Evaluation

A critical strategic design decision in the development of a game or simulation is where these outcomes lay on a training and evaluation continuum (see Table 1). This continuum represents how much the designer wants a given outcome to be taught to the participants and to what extent the audience should be evaluated on a given outcome.

Table 1: Training and Evaluation Continuum

Aspect	Training	Evaluation
Participant Content Familiarity	LOW	HIGH
Level of Detail	LOW	HIGH
Level of Fidelity	LOW	HIGH
Level of Authenticity	LOW	HIGH
Frequency of Debriefing	HIGH	LOW
Degree of Feedback	HIGH	LOW
Complexity of Experience	LOW	HIGH
Degree of Problem Solving	LOW	HIGH
Degree of Experimentation	HIGH	LOW
Consequences of Failure	LOW	HIGH

This has important tactical considerations, particularly in simulations. Simulations that are designed to teach more than evaluate will have more frequent debriefing and feedback on performance throughout the experience. Conversely, simulations that are primarily meant to assess the performance of the audience on a given set of objectives will have less debriefing and feedback on performance and likely not till the end of the experience. This training and evaluation continuum is important for a designer to consider, given the dichotomy between training and evaluation when it comes to debriefing and feedback. If the designer provides a deep level of debriefing and feedback, while useful for training purposes, this feedback may actually help to improve performance by providing hints, strategies, and tactics. This level of feedback is not typically desired in evaluative simulations where the audience should not be assisted so that performance can be more accurately measured.

When considering participant actions, the different purposes of training and evaluation affect the demand for fidelity in the simulation. As mentioned earlier, the *level of fidelity* of critical *aspects* of the game or sim may vary depending on the degree that that they must have detail that reflects real world imagery. The more towards the training end of the continuum, less fidelity is needed based on participant actions, since debriefing and feedback can be used to get the participant back on the right track. But towards the evaluation end of the spectrum, more fidelity is required, since the participant should witness the outcome of his/her actions, which requires more paths through the experience and the development of more content. Since debriefing and feedback are less frequent, the experience must simulate reality at a higher level of fidelity. When imagery is not important such as simulating a phone call between two individuals, then less fidelity is needed. However, w0hen imagery is critically to the core objectives of the game or simulation such as accurately identifying an enemy vehicle, then the *level of fidelity* is important. With computer based games and simulations, more visual fidelity typically means more time and costs for development, but this is not always the case if the designer can target the key content aspects where *level of fidelity* needs to be high.

Game And Simulation Rules And Models

The importance of understanding what it to be modeled in the game or simulation cannot be underestimated. In a game the rules are the driving factor for scaffolding and in a simulation the model determines what can or cannot be done. Because many games and simulations need very detailed designs in order to achieve a high *level of authenticity*, a thorough understanding of the concepts for the rules or model is critical. For example, if a designer wanted to model the throwing of a ball in a virtual environment, an exact understanding of physical and gravitational forces would need to be understood for the simulation to work authentically. However, rarely have rules been clearly stated, nor are models as straight forward as the scientific principles of gravity and physics. In the beginning the designer will not often know the intricacies of what is to be simulated. For example, if a designer wanted to simulate a discussion between a sales person and a client, and wanted the client to respond to the salesperson in an authentic manner, the designer would need an understanding of common client reactions to sales tactics. This type of knowledge is more nebulous and is often spread

across the collective understanding of the sales staff rather than gathered in a single location. Harder still is designing simulations or games that are based on complex models, such as the effects of resources allocation on the market share of a given product. These models can be even harder to define because of the multitude of variables that affect the final outcome. For this purpose, the designer must know where and who he/she can turn for information that can help to build an accurate model with a high *level of authenticity*. Sometimes this exists already, such as the ball and gravity example, but often times the designer will need to seek it out in the form of subject-matter experts (SMEs). The designer needs to make an honest assessment of how much is known about the model to be used and what resources are needed to get the model to a state where it can be used for a game or simulation.

Determining the rule set or model to be used can also have influence on the modality of the game or simulation. If the designer encounters more of a set of dos and don'ts, then a game intervention might work best; however, if a set of if/then decisions are encountered, a simulation might meet the outcomes better. Models that involve interpersonal communication and emotional engagement may be more suited for face to face simulations or games where reading facial expression and voice tone are more easily accomplished, while complex models that rely on thousands of calculations to predict the outcome of participant actions often need to be delivered via computer technologies.

Play Time, Apperception Of Content, And Complexity

Games and simulations can take as little as a few minutes and as long as weeks or months to complete. The participant may be exposed to only a small fraction of the content, or may progress through the majority of it, depending on the way the game or sim is designed. A key concept here is the difference between the perception of the game from the designer's point of view and the view of the participant. To the designer the game or sim will have multiple paths a participant can take, and all these paths must be developed, even though any given participant might not experience it. A participant can only traverse a game or sim along a linear path, even though they might back up to a decision node and progress a different direction. The branching remains the same, but the time of play increases. Attempting to anticipate what a participant will do within a game or sim is the difficult part of design in these modes. A designer should consider how long, on average, it should take participants to complete the game or simulation. Often, the longer the experience, the more time and resources are required to build it.

Debriefing And Feedback Complexity

Appropriate and timely feedback to players is a primary advantage of face to face modalities. The amount and type of debriefing and feedback provided in a virtual mode will determine its complexity as well as the time and resources needed to develop it. The more frequent debriefing and feedback or correlation to the participant's actions, the more content must be written for the feedback. For example, if the participant can make four different choices, there may need to be four different types of feedback based on the choice that we made. In addition, while immediate feedback will likely only deal with a few variables, summative feedback may potentially deal with the

combination of several variables over time, making the debriefing and feedback more complex.

Development Focus

Within the *development focus* are three basic phases of planning, creation, and implementation. Although these phases do have a strong linear coupling, an iterative development model flows through them a number of times generating ever increasing degrees of functionality and fidelity. This is also referred to as a rapid prototyping model that allows for natural milestone events where formative evaluation may occur allowing other members of the organization to have input. Although the general path though the development focus is the same for all modes, each mode of delivery is unique enough to warrant individual descriptions of the *development focus* below (Appelman, 2000; Bethke, 2003; Toth, 1997; Tripp & Bichelmeyer, 1990).

Time And Resources

After the audience, purpose, and model of a simulation and game have been determined, the designer must also consider the time and resources available for development. Games and simulation can be very inexpensive to create or extremely expensive, and the designer should have an understanding of what mode is being dealt with. In an emergent form of a spiraling development model, it is easy to spiral out of control if there is no overall plan or experience in developing whatever mode is being targeted. A spiral model requires a team of experts, subject matter, instructional design, mode design specialists, and project managers, all who are willing to keep coming together to evaluate and redirect the development toward the desired outcome. Conferences, web resources, and publications are increasingly available for detailed exploration into this complex development process (Bethke, 2003; Rollings, 2000; Zimmerman & Salen, 2004) (http://www.gamesconference.org , http://www.igda.org , http://www.siggraph.org , http://www.isaga.com , http://www.nasaga.org , http://www.digra.org , http://www.imixedreality.org).

Performance Tracking And Scoring

As with other types of training and evaluation, designers should consider how participant performance will be tracked and scored. This can be as simple as facilitator observation or self reporting, or as complex as reporting performance scores to online learning management system for analysis and reporting. Performance tracking and scoring is determined largely by the modality of game or simulation delivery, but its importance can not be understated. Tracking participant performance not only help deliver accurate feedback during the simulation or game, but also helps to have more effective debriefing sessions after the simulation or game is completed. The good news is that in a virtual world, everything is data, and very easy to capture and report. The question will be what to report in light of the desired outcomes, and who to report it to. The more accurate, timely, and pertinent the performance data the more likely that effective feedback and instruction can be provided to improve performance.

ROI AND SUMMARY

Throughout this chapter we have attempted to identify variables that illuminate the similarities and differences between games and simulations, as well as to provide discussion that would engage you in the decision making process matching your training needs with these modes of interventions. As you approach your own needs, we suggest you fully understand the opening definitions and then move to the 'training and evaluation continuum' matrix where you can begin matching your context needs with cells in the matrix. As the description of your particular solution takes shape, the case studies and specific discussion areas will be good question generating exercises that will require you to ask critical questions of your mode and audience experience to produce the desired training outcomes.

A key decision of whether to use a game or sim is the 'cost of failure,' and stated simply, the cost of failure is the 'cost' that an organization or individual would pay if an individual or group of individuals fails at a given task in the real world. This cost might be missing a sales quota or not accurately assembling a piece of machinery. It can be as benign as not answering phone calls in time or as serious as a pilot losing his life in a plan crash. The high cost of failure in terms of human life and equipment is the reason why military forces around the world have some of the most sophisticated simulations and games known to man.

The final recommendation is to avoid selecting a game or simulation because it just seems like a neat thing to do, or your employees would like to have 'fun' learning (Appelman & Goldsworthy, 1999; Crawford, 1984; Thiagarajan, 1994). Instead, determining where both your organization and participants are with respect to role-playing, using technology solutions in training, and even their familiarity of playing video games. Experimenting with these different experiential modes would provide you with some evaluative information that could point to a development starting point (Herz, 1997; Summers, 2004). Perhaps it would be to first develop some face to face group activities, then move to some off the shelf training modules. If you have a population that is amenable to high tech solutions, then you could consider creating some simple low fidelity branching PowerPoint games to become familiar with the development decisions discussed here. Once you feel you have reached a critical confidence level of support from your organization and employees, then would be a good time to look for game and simulation development companies that could work with you to determine the best level of fidelity and authenticity for your context.

As many are touting the values and potentials for learning of games and simulations (Amory, Naicker, Vincent, & Adams (YEAR); Crawford, 1984; Filho, Hirata, & Yano, 2004; Gee, 2003; Gibbons et al.; Jones, 2003; Klabbers, 2003; Kommers, 2003; Rollings, 2000), the main goal is for you and your design team to experience these rich learning environments yourselves. You need to examine the characteristics of content density, what is challenging, the experience of low consequence failure, and how rewarding it can be to achieve a goal in a game, or to reflect on the consequences of your experience in a simulation. Even if you decide it is not for your organization at this time, you will be making that decision from experience, and you will know when the time is right for these immersive learning environments.

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