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MAXIMIZING LEARNING GAINS IN SIMULATIONS: LESSONS FROM THE TRAINING LITERATURE

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ABSTRACT

The purpose of this paper is to offer suggestions from recent training research to increase the student learning gains resulting from participation in business simulations. We review research on human learning, provide recommendations based on the literature, and offer examples that illustrate how to apply our recommendations to enhance student learning when using business simulations.

INTRODUCTION

The purpose of this paper is to offer suggestions from recent training research to increase the student learning gains resulting from participation in business simulations. The training literature offers conclusions that have relevance for improving our understanding of why business simulations are effective learning tools and for ways that instructors can enhance their use of the simulation to increase student learning. The tips we offer in this paper are heuristics rather than proven techniques, inferred from summaries of research on human learning and transfer of training, and based on our own experiences in using simulations to enhance -the student learning experience.

We begin by briefly reviewing the simulation experience in order to establish a common basis for our recommendations. We then review research on human learning and performance that describes a convergence of opinion among learning researchers on broad learning principles. In this review, for the sake of brevity, we focus on literature not ordinarily examined by the simulation research community. For each conclusion from the research, we offer suggestions for how instructors can use the learning principles to improve student learning in the simulation.

THE SIMULATION EXPERIENCE

Burns, Gentry, and Wolfe (1970) note that while the content of simulation exercises may vary, the exercises themselves entail some common dimensions such as duration, simultaneous handling of multiple decision variables, intergroup competition, and varying degrees of realism. Anderson and Lawton's (1997) recent review of the current state of simulations and simulation research echo Burns et al. (1970). contending that it makes little sense to talk about "the" simulation experience as if there is but one form that all learners experience. Yet they also agree that common attributes exist for simulations, identifying the requirement that all participants must make decisions under conditions of uncertainty.

Anderson and Lawton (1997) also outline learning objectives common to simulation exercises. These include outcomes such as increased knowledge of facts and concepts of the business discipline; improved skills in analysis, critical thinking, decision-making, and interpersonal relations; enhanced ability to simultaneously manage interrelationships; and a better understanding of business dynamics. In summary, regardless of whether a business simulation exercise is discipline-specific or a total enterprise model, all simulations contain the elements of being interactive, integrative, and iterative.

We also note that simulations are intended to reflect or mimic important features of real performance situations. That is, simulations are based on the idea of identical elements from industrial training, in which elements in training settings are matched as closely as possible with key features of performance settings (Goldstein. 1993; McGehee & Thayer, 1961). Thus. learners can practice their newly acquired skills in a setting that is more realistic than other learning modes such as lectures or case discussions. This also allows learners to test ideas that they might not get a chance to try (or that could not be tolerated) in the performance setting of a real business. In addition, simulations allow students to make and correct mistakes in the simulation without the severe penalties that might occur in real settings. In general, the greater the match between the elements in training and performance settings, the greater the expected transfer of knowledge and skills across settings (Mosel, 1957).

This paper builds on the common elements of the business simulation experience by examining the key conclusions from the recent training literature to examine how the business simulation experience could be enhanced by using learning principles identified in that literature. Before turning to the conclusions from the literature and their implications, in the next section we examine the most relevant research programs that generate the conclusions.

RECENT TRAINING RESEARCH DEVELOPMENTS

Two research programs offer particularly useful information for improving simulation-based learning. The first program involved efforts by the National Academy of Science to summarize what is known about improving human performance (Bjork & Druckman, 1991). A National Research Council committee, assembled by the National Academy of Science, examined evidence about training to enhance post-training performance in real world settings. This idea of enhancing post-training performance in real world settings is termed "transfer of training." They noted that skills and knowledge learned in training are often not durable or flexible, particularly when long intervals of disuse occur, which is common in many settings, including in business management. That is, the skills acquired or demonstrated in training often do not appear to transfer back to the performance setting. They offered several specific suggestions to improve the prospects that skills acquired during training will be available for use in settings beyond the training context. While the techniques they discuss increase difficulties for the learners, the process of responding to those difficulties appears to produce more durable and flexible learning.

A second research program has revealed that ability requirements change for learners as they proceed through a complex task (Kanfer & Ackerman, 1996; Kanfer, Ackerman, & Heggestad, 1996). Kanfer and her associates have developed a model to account for changing skill requirements while learning a complex task. They theorize that cognitive resources are finite, and that attention is divided among (a) focus on task, (b) focus on non-task stimuli, and (c) focus on emotional and motivational self-regulation. They find that task learning increases as focus on task increases. Thus, the instructor can help students maintain and improve focus on task and subsequent performance by use of attentional resources to maintain emotional calm and to keep them motivated to continue to learn and perform.

In each of the following sections, we explain one of the key conclusions from the training literature as well as the implications of the conclusion for structuring the business simulation experience.

USE SPACED PRACTICE RATHER THAN MASSED PRACTICE

Research Conclusions

Some techniques that speed up skill or knowledge acquisition during training may actually impair transfer of those skills outside the training setting. For example, massed practice, in which the learner practices the new skill in one large practice session, can result in dramatic skill gains in very short periods of time, but the skills are not firmly acquired and fail to appear when needed subsequently in the work setting (Bjork & Druckman, 1991). The evidence indicates that practice should be distributed over numerous sessions with substantial breaks rather than using massed practice. Breaks may allow time for the physical changes with learning to occur among neural connections ("How does learning...," Sept. 1991). College schedules typically reflect this approach (e.g., 3 contact hours weekly, spread over 15 week semesters), whereas work place training programs are more likely to use massed training.

Implications for Improving the Simulation Experience

Application of this training principle to a simulation exercise argues for spacing between decision rounds. If students are to be able to assimilate the learning that results from exposure to a simulation, they need time to process what they have experienced and how it fits with other information they have acquired. Since one of the intended outcomes of a business simulation is the application of business theories and concepts to the exercise, students should be provided the time to make the connections. A series of back-to-back decision rounds in a single session works against any reflective learning by preventing consolidation and integration of new information. This can result in students simply randomly trying different scenarios without understanding why a particular scenario was successful or unsuccessful, rather than thoughtfully testing business ideas.

Instructors should also consider how frequently the class meets in establishing the timetable for decision rounds. Some classes meet three times a week for one hour each, while other classes meet one night a week for three hours. Instructors should be careful about requiring students to complete multiple decision rounds in a single class session unless students have the time between decision rounds to reflect on the lessons learned in the previous decision round.

CREATE VARIABILITY IN THE CONDITIONS OF PRACTICE

Research Conclusions

A variety of interfering events and circumstances should be offered over the practice sessions, in order to more fully reflect the messy reality of the work place performance context (Bjork & Druckman, 1991). As skills are practiced under varying conditions, they become more robust and generalizable.

Implications for Improving the Simulation Experience

Instructors can create a messy environment for student practice in the simulation in several ways. For example, if the instructor introduces a decision round that does not appear on the schedule, then students might complain that “my marketing guy ain’t here.” Since this correctly captures the messy nature of the real world, students learn from the simulation experience. For example, in the real world of business, the marketing expert is sometimes out sick, but the managers still must make decisions to keep the business functioning.

Furthermore, simulations by design usually have many instructor-controlled variables that can create variability. For example, instructors can introduce ethical and other dilemmas to make the learning experience using the simulation less predictable than other modes of learning such as lectures or case discussions. An instructor can also introduce changes to the costs associated with managing the simulated company, or suddenly cause a recession in the economic environment.

Thus, rather than letting the decision rounds become routine, an instructor should create new forms of uncertainty into the simulated environment, beyond that caused by the competitors in the industry. For example, an instructor could announce that a substitute product has just been introduced by a new company, which will drop demand for existing products by 20%. Or companies could be required to negotiate a new labor contract or face strike action by company workers. Both of these situations would require students to rethink their current strategies for their companies. This, in turn, could prompt them to reflect on the underlying precepts for the simulated environment and the business principles they have been applying to the exercise.

DECREASE THE FREQUENCY OF EXTERNALLY-GENERATED FEEDBACK AND INCREASE USE OF SELF-EXPLANATION TECHNIQUES BY LEARNERS

Research Conclusions

Instructors have a prior template (i.e., framework of understanding) that they bring to bear to solve problems that novice learners do not possess. Novices need to develop their own template. so that it travels with them beyond the training setting. The training literature concludes that *self-explanation,* in which learners explain to themselves the nature of the problem, how it relates to previous information, and what might result from different courses of action, is a powerful method for retention of knowledge or skills beyond the training sessions (Bjork & Druckman, 1991). Part of that process of self-explanation requires learners to decide how they will know if they have achieved the objectives they desire-in essence, developing their own feedback standards and mechanisms. Unfortunately, feedback that is defined, controlled, and delivered exclusively by the instructor may actually inhibit the development of the novice’s template for feedback, understanding, and action. Therefore, instructors need simultaneously to reduce their own feedback giving, while encouraging learners to develop their own feedback systems.

In particular, the literature suggests that peer tutoring, peer problem solving, and peer learning are more effective than other methods because there is more opportunity for the learner to self-explain (Bjork & Druckman, 1991). “Most of what novices do in self-explanation is to provide justification for action steps and for the consequences of actions. And second, by articulating it tacitly or overtly, they are creating conditional action rules that they can remember. The creation of those rules allows them to access them and use them on other problems” (Michelene Chi, quoted in “Good training...,” Nov. 1991, p. 16). This implies that simulation participants should discuss and develop what their objectives are and how they’ll test if objectives are achieved, rather than having the instructor impose such standards and mechanisms.

Implications for Improving the Simulation Experience

You learn something best when you have to teach it to someone else. Simulation team members have ample opportunity to teach each other across business functions, especially if the instructor constructs teams of students with different talents, skills, and abilities, and then encourages them to use self-explanation. If a student runs into a problem outside of his or her area of expertise, the instructor can encourage the student to go to his or her fellow teammates who have the needed expertise, thus providing the other teammates with opportunities for self-explanation. Instructors can warn participants that they need to know everything, not just their area or areas of responsibility.

Some business simulations also feature a version in which a student can run the simulation by himself or herself, competing against computer-run companies. An instructor can require students to use the play-alone version to force students to practice skills outside of their area of expertise. These play-alone practice sessions encourage the students to self-explain what they are doing across functional skill areas so that individual weaknesses are not hidden behind a teammate's strengths.

One of the strengths of the simulation experience is that it allows students to test their ideas and learn from their actions, rather than depend on being told what to do. However, students do want to succeed at the exercise, for both ego and grading reasons. So it is natural for them to seek advice from the instructor, especially if their company is experiencing difficulties. For the instructor, there is a fine balance that has to be drawn between two opposing needs. One is to provide advice, so that the students do not become frustrated and give up on the exercise. The other is to take a Socratic position and let the students learn through self-discovery. Applying this training principle to a simulation exercise argues that instructors should caution against becoming too intrusive into the students' management of their company.

The instructor's objective of reducing feedback while encouraging self-explanation is to shift some of the burden for learning from the instructor and onto the student. Written assignments built into the exercise can also encourage self-explanation. Instructors could require students to turn in individual explanations for their decisions with each decision round. In addition, instructors may require strategic plans, analyses of the industry, and final papers and oral presentations to the class and instructor. Often outsiders enact the roles of bankers, brokers, customers, lawyers. stockholders, or owners in such assignments. These course requirements all encourage the students to reflect on their actions and decisions, and to explain them to others. These explanations should include a discussion of why the students chose a course of action, what business concepts and theories they applied to the decisions they have made, and what consequences they foresaw. This will force students to make explicit what they have been doing implicitly and incompletely.

USE COGNITIVE REHEARSAL JUST PRIOR TO PERFORMANCE

Research Conclusions

There are a variety of ways one can prepare for the performance of a skill or task, including a mental rehearsal, in which the person envisions the performance without actually performing the skill or task, and a physical rehearsal, in which the person actually performs the skill or task. Research suggests that these preparation strategies may prime or stabilize cognitive/motor skills that underlie performance, thus helping subsequent performance (Bjork & Druckman. 1991).

Driskell, Copper, and Moran (1994) conducted a review and meta-analysis of the mental practice literature, examining if the evidence supported claims that mental practice enhanced performance. The short answer was yes-for cognitive as well as for physical tasks. They defined mental practice as cognitive rehearsal prior to performance in the absence of overt physical movement. They distinguished it from mental preparation, which may include "psyching up," relaxation, and other activities not considered a mental rehearsal of the actual tasks.

In particular, Driskell et al. (1994) found that the effectiveness of mental practice was moderated by the type of task, the retention interval between practice and performance, and the length or duration of the mental practice. For physical tasks, mental practice had a positive effect that was weaker than added actual physical practice. For mental tasks, mental practice had a more positive effect the more the task involved exclusively cognitive activities. Further, mental practice had a less positive effect the longer the delay between practice and performance. Finally, a diminishing rate of return was noted-the longer the duration of mental practice, the smaller the gain per trial or per time unit. Put together, it appeared that learners could maintain and improve performance if they mentally practiced the correct sequence of tasks for about 20 minutes just prior to actual performance.

Implications for Improving the Simulation Experience

The simulation experience itself serves as a kind of rehearsal for the real world of business decisions. Business simulations are often used as the capstone experience in a college curriculum, just before the students graduate and take their next job.

However, the rehearsal that occurs in a business simulation may still occur weeks or months before the students start applying the skills on their jobs. One challenge, therefore, is to develop ways to encourage students to engage in mental rehearsals while engaged in the simulation. One way for instructors to encourage students to engage in cognitive rehearsal during the simulation is to require students to think through the decisions they have to make before they turn on the computer to enter their decisions and perform their what-if analyses. A related challenge for instructors is to get students to learn to use cognitive rehearsal techniques in real world business situations. When students get practice using cognitive rehearsals during the simulation, they learn the value of cognitive rehears als. which makes it more likely they will use the technique on the job.

Another example concerns rehearsal prior to oral presentations. Instructors could allow students who are to present next to have about a half-hour alone outside the classroom to rehearse. The result should be improved presentations.

SUPPORT EFFICACY EXPECTATIONS AND SUPPORT OUTCOME EXPECTATIONS

Research Conclusions

Learning theorists divide learning complex tasks (such as learning to run a business) into three phases. In first phase, called the “cognitive” phase, the learner begins to understand the basic task requirements and the rules for task engagement (Kanfer & Ackerman, 1996; Kanfer, Ackerman, & Heggestad, 1996). In this phase of learning, attentional resource demands are high (i.e., the learner must focus a great deal of attention on learning). Variations in cognitive abilities across learners relate substantially to performance scores. That is, students with high cognitive abilities learn faster, and so tend to perform better. In this phase, students tend to learn factual information and concepts relevant to the task (Ackerman, 1992; Anderson, 1987; Howell & Cooke, 1989).

The second phase, named the “associative” phase, involves strengthening associations developed in the first stage (Kanfer & Ackerman, 1996; Kanfer, Ackerman, & Heggestad, 1996). In this learning phase, attentional demands decrease, while performance accuracy and speed increase. In this phase, facts and behaviors that go together are integrated into a routine (Ackerman, 1992; Anderson, 1987; Howell & Cooke, 1989).

In the “autonomous” third phase, there are minimal attention requirements as the task has become automatic for the learner (Kanfer & Ackerman, 1996; Kanfer, Ackerman, & Heggestad, 1996). In this phase, performance is generally fast, accurate, and low-effort.

The challenge for instructors is to help move students through the three phases of learning. Strong emotional states, particularly negative states such as frustration or anger, interfere with learning. In contrast, mild positive feelings (i.e., how you might feel when receiving an e-mail from an old friend) favorably influences the manner in which information is organized, and improves the ability to integrate divergent information (Bretz & Thompsett, 1992). Kanfer and her associates theorize that use of attentional resources to maintain positive emotions will be especially helpful in the first phase of learning, when high cognitive resource demands are present.

By contrast, learners face boredom as they approach the third, rather routine, phase of learning. Attentional resources that are directed toward motivational control techniques (such as self-set goals or competitions) will help keep focus on task during that phase. In summary, learners must direct attention to keep emotions in check early in learning, and motivational control late in the process to keep focused on task.

Kanfer and her associates developed a simulation to teach air traffic controller skills and trained novice controllers. The data from their studies showed, in part, that the correlation of a general cognitive ability measure with performance was strongest with first phase results and weakest with third phase results. This implies that differences in cognitive ability are more important early rather than late in learning. They also found an interaction involving general cognitive ability and the importance of emotional or motivational control. Specifically, lower cognitive ability learners were more likely to experience frustrations leading to negative emotions early in learning, when cognitive resource demands are high. Methods to encourage emotional control were more important for lower-ability learners than their high-ability counterparts at this early phase in learning.

These research findings suggest that instructors could provide support for emotional control by bolstering learner efficacy expectations (Bandura, 1977). The self-efficacy expectations of learners can be enhanced by (1) persuasion, in which the instructor verbally assures the learners that they can be successful; (2) modeling, in which the learners are shown (live or on video tape) others like themselves who have been successful in previous training sessions; and (3) enactive mastery, in which the instructor takes steps to cause the learners to experience successes early in the training program (Gist & Mitchell, 1992; Gist, Schwoerer, & Rosen, 1989; Mathieu, Martineau, & Tannenbaum, 1993).

Two points should be kept in mind when using persuasion to enhance student efficacy expectations. First, efficacy concerns can be quite specific, such as a student not knowing how to format a floppy disk. Instructors should therefore build a student’s efficacy expectations by using facts arid examples that are as specific as possible to the task that has triggered the student’s concerns. Second, efficacy is a reality-driven belief. Therefore, examples from real life successes are going to be more effective than parable-based or celebrity-based stories that are much more removed from the reality of the student’s life.

An instructor can use modeling to influence self-efficacy through demonstrations (e.g., have a comparably-skilled student show the new learner how to perform), or a more vicarious form (e.g., share with the student a story about previous students of similar background and concern who survived and prospered). Enactive mastery techniques require close interaction with the student, so that the instructor can help the student overcome obstacles with real time support, and also so that the instructor may help highlight intermediate successes that the student has achieved while working themselves through the task about which they harbored self-efficacy doubts.

Late in learning, the high-ability learners were more susceptible to boredom, requiring attention to motivational control. Methods to “keep the interest going” were more important for the high ability learners than their less-able counterparts in that third phase. Use of self-set goals was one motivational tool identified that helped maintain attention and performance. Therefore, the results from the Kanfer and associates research program imply that some learners may require more instructional attention at the early learning phase in a simulation and it will more likely involve emotional control support; others will need that attention later in the process, primarily in the form of motivational control support. Individual differences in general cognitive ability, in emotional self-regulation, and in motivational self-regulation will produce differences in the type of instructional support needed among different learners at different phases of learning in simulations.

Implications for Improving the Simulation Experience

A major task of any instructor is to help students understand that they can do the task and that they can do it themselves. This principle supports an instructor taking an active advisory role early in the exercise, especially for students who are experiencing a simulation for the first time and for low-ability participants. The combination of student insecurities and exercise complexities can distract attention to the task and result in negative attitudes toward the experience. Providing students the emotional support needed when they first attempt to process the heavy flow of new and different information and stimuli will facilitate their ability to keep focused and enhance their learning outcomes. For example, this emotional support can be presented in the form of helping a struggling team search for attainable goals such as getting out of last place or beating their nearest competitor.

Instructors can bolster students’ efficacy expectations through persuasion by telling students that their concerns and feelings of frustration are common. In addition, instructors can reassure students that they will quickly succeed, as previous students have done. The students’ efficacy expectations can be enhanced through modeling by having successful students from previous terms come into the class and demonstrate the required skills. Instructors can also ask students at the end of one term to write memos to the next term’s students about how to succeed in the simulation. Self-efficacy expectations can be improved through enactive mastery. For example, an instructor can keep a second computer in his or her office to allow students to work shoulder to shoulder with the instructor. This way, the instructor is available to provide real time help, minimizing frustrations and improving confidence in the student’s skills.

Once students have learned the mechanics of the simulation and understand the basic relationships involved in making decisions, this principle argues that the instructor should shift his or her focus to the performance of the student-run companies. The instructor should help students set expectations of financial success, so that the students recognize the need for them to move beyond learning about the simulation details and on to being able to successfully manage their environment. They need to know not to just learn from their mistakes, but also to apply that learning to future decision rounds. Otherwise, the students will be content to “know how to play the game” rather than “manage the business.”

Later in the exercise, instructors may need to pay more attention to high ability participants, encouraging their motivational self-regulation as the simulation becomes more routine for them. That is, the instructor should provide additional forms of motivation later in the exercise for the high ability students who are clobbering their competition in order to keep their motivation levels high. For example, instructors can provide championship awards such as championship t-shirts, certificates of achievement, trophies, and place photographs of the winning team members in prominent locations.

CONCLUSIONS

The literature on improving human performance supports the following learning recommendations:

1. Use spaced practice rather than massed practice.
2. Create variability in the conditions of practice.
3. Decrease the frequency of externally generated feedback and increase the use of self-explanation techniques by learners.

4. Use cognitive rehearsal just prior to performance.
5. Support efficacy expectations, especially early in learning, encouraging emotional self-regulation so that the learner maintains mild, positive feelings, and support outcome expectations later in learning, encouraging motivational self-regulation so that the learner values achievement of learning objectives.

We have offered several suggestions and examples of how simulation-based learning might be improved based on research on human learning and performance. At some level we all probably struggle with guilt because we don't always deliver instruction that fully reflects the current wisdom or best practices available. Inducing guilt is not our main purpose, however. Rather, we believe that if we keep in mind the advice based on best practices, we are more likely to move in the right direction when we do have an opportunity to change the content, formats, schedules, or resources we use to deliver the best simulation training we can. It is not a question of whether or not we are perfect -it is whether we can improve on current practice using simulations with suggestions from training research. On that point we are quite optimistic.

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