Business simulations & cognitive learning: Developments, desires, and future directions

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This article focuses on the research associated with the assessment of the cognitive learning that occurs through participation in a simulation exercise. It summarizes the objective evidence regarding cognitive learning versus the perceptions of cognitive learning achieved as reported by participants and instructors. We also explain why little progress has occurred in objectively assessing cognitive learning in the past 25 years and potential options for filling this deficiency.

KEYWORDS: assessment; business simulations; cognitive learning; objective measures; perceptions

In this paper we attempt to

1) outline what instructors hope simulations will accomplish and what they consider to be the educational benefits of simulations;
2) summarize what is known about the educational outcomes of business simulation exercises;
   a. what is known about the effect of simulations on *cognitive knowledge* about the discipline;
   b. what is known about the effect of simulations on *attitudes* toward the course and/or the discipline;
3) explain why little progress has been made in our knowledge of learning outcomes; and
4) suggest potential avenues for advancing our knowledge of the efficacy of simulations for learning.

The scope of the inquiry

This paper is concerned with assessing learning for only a subset of business simulations. We have limited our scope because the term “business simulation” covers such an extremely broad range of activities that it would be impossible to draw valid conclusions across this entire spectrum. The interesting classification of simulations by Lean et al. (2006) illustrates nicely just how much ground business simulations cover. We restrict ourselves here to computer-based simulations in which students or, more typically, teams of students compete. A computer model attempts to reflect the basic dimensions of a business environment and the students vie either against each other or against a set of computer competitors to achieve success in the simulated marketplace. Simulations typical of this genre include total enterprise simulations and computerized marketing simulations.

Throughout this paper we draw a distinction between assessments based on *perceptions* of learning versus assessments based on *actual*, *direct* evidence of learning. The literature refers to the latter as *objective* evidence, but, in fact, these assessments may range from something as objective as a multiple choice test to something as subjective as an instructor’s personal evaluation of a student’s performance; the real point of distinction is whether the assessment is or is not based on the perceptions of the participant or the instructor. To be consistent with the literature, we will refer to evaluations that are grounded in evidence other than perceptions as “objective.”

What instructors believe simulations accomplish

Instructors may adopt simulations in an attempt to achieve any of a number of outcomes. Over the past four decades, scores of journal articles and countless conference presentations have offered myriad explanations as to why simulations are and should be used. Often these explanations are expressed as advantages of simulations over alternative pedagogies. The major desired outcomes typically can be sorted into three categories (See for example, Faria, 2001; Gentry & Burns, 1981; Hsu, 1989; Knotts & Keys, 1997; Wolfe, 1985):

1) Learning.
    a. teach students the terminology, and the concepts and principles of business in general or of a specific discipline.
    b. help students grasp the interrelationships among the various functions of business (marketing, finance, production, etc.).
    c. demonstrate the difficulty of executing business concepts that appear relatively simple. (Requiring students to implement concepts often leads them to discover that activities such as developing a business plan *and successfully implementing it* are significantly more challenging than reading about them or hearing about them in a lecture might communicate.)
    d. enhance retention of knowledge. (It has been long accepted that participation in an activity yields greater retention of concepts and relationships than does a more passive educational pedagogy.)
    e. enable students to transfer learning to the business world. (Because simulations require participants to act in the role of a manager, simulation users point to the face validity of simulations as evidence that students will have an easier time transferring what they learned in the classroom to the world of work.)
2) Attitudinal.
    a. improve student attitudes toward the discipline.
    b. provide a common experience for class discussion. (This may be especially germane for undergraduate students with little business experience.)
    c. engage students in the learning process.
3) Behavioral.
    a. teach students to *apply* the concepts and principles of business to make effective decisions.
    b. enable students to *implement* course concepts. (The requirement to implement rather than merely discuss course concepts allows students to test ideas, experience the consequences of their actions, and respond to unanticipated outcomes.)
    c. improve students' ability to interact with their peers. (Since most instructors using simulations have their students work in groups, the belief exists that students will learn interpersonal skills during the course of play.)
    d. give students practice at making business decisions.
    e. improve students' business decision skills.

The foregoing shows the wide range of objectives instructors may hope to achieve through using simulations. It should be pointed out that these aims are not mutually exclusive. In fact, most instructors undoubtedly hope to achieve multiple outcomes simultaneously. It also is worth noting that there are strong reasons to suspect that simulations are likely to be considerably more effective in delivering some of these learning outcomes than others. The literature on business simulations shows considerable consensus concerning what simulations should do well and what they may not do well. (See, for example, Faria & Wellington, 2004; Fripp, 1993; Lean et al., 2006; Saunders, 1997.) To be effective simulations require a substantial time commitment from participants. Consequently, the literature suggests that business simulations are an inefficient pedagogy for teaching terminology, factual knowledge, basic concepts, or principles (1a above). The basics of a course can be covered more quickly in lectures. It may be an open debate as to whether students will be able to retain or implement some of these basics if lecture is the sole method of delivery, but few will dispute that lectures are much faster.

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The literature also implies that simulations are somewhat less effective than other pedagogies at teaching the application of specific applications or concepts. Simulations of the type considered here are multifaceted and amorphous. If an instructor wants a student to learn how to conduct break-even analysis or consider the implications of a particular course principle like the product life cycle, a case that focuses attention on a narrowly-defined issue may be more efficient.

Given the diversity of purposes for which simulations are used, it is no surprise that it has been difficult to devise a simple instrument that measures the effectiveness of simulations and equally difficult to generalize the results of studies that assess the educational value of simulations.

The educational outcomes of business simulation exercises

For over 25 years, many researchers have used Bloom's Taxonomy of Learning Objectives (Bloom, et al., 1959) to guide their investigations of the learning resulting from business simulations (Gentry & Burns 1981; Gosen & Washbush, 2004; Wolfe, 1985). In many respects, Bloom's Taxonomy has been the anchor for assessing whether learning occurs in business simulations. Since Bloom's Taxonomy provides the framework for organizing the literature on the learning outcomes of simulations, we briefly summarize the taxonomy here.

Bloom's Taxonomy classifies learning outcomes into three domains (Bloom, et al., 1959; Krathwohl, et al, 1964): cognitive (knowing), affective (feeling), and psychomotor (doing). Each of these domains has stages of learning unique to that domain. This taxonomy has proven useful for researchers in all fields of education. By identifying the domain and the stages within them, educators and researchers have been able to distinguish more clearly the particular learning outcome(s) they are pursuing as well as the degree to which the outcome has been accomplished. Following a brief overview of what we know about the relationship between simulations and the affective and psychomotor domains, this article will focus on the cognitive learning outcomes of business simulations.

Business simulations and affective learning

A substantial share of the early research on simulations focused on the attitudes (affective domain) of participants exposed to the pedagogy. Much of this initial research focused on comparing the general perceptions of students regarding cases, lectures, and simulations. (See for example, Anderson & Woodhouse, 1984; Blythe & Gosenpud, 1981; Fritzsche, 1974; Mancuso, 1975; Wolfe, 1975). Subsequent research expanded into attempting to assess *what* is learned from participating in a simulation, rather than simply the perception of *whether* learning occurred. As will be discussed later, while most of these later studies purported to measure actual gains in cognitive learning, they relied on perceptions and self-reports of learning rather than more objective measures. If we restrict our focus to only those studies that aim at examining participants' affective reaction to simulations, we find that, with few exceptions, students like simulation exercises and view them more positively than either lectures or case discussions. (See reviews by Burns, Gentry, & Wolfe, 1990; Faria; 2001; Gosen & Washbush, 2004).

It is worth noting that these relative comparisons have been made by students experiencing different pedagogies *within* a course. There is a dearth of studies employing experimental designs with control groups or where comparisons are made between student attitudes in one section of a course that is solely lecture-based versus those in a class that is solely case discussion-based or solely simulation-based. This lack of research employing control groups characterizes not only research on attitudes, but also extends to studies focused on psychomotor and cognitive learning reported in this paper.

Recently, Anderson and Lawton (2004a, b, 2005, 2006, 2007) extended the simulation literature to include problem based learning (PBL). PBL is a pedagogical approach that reverses the typical order of presentation. In contrast to the traditional Subject Based Learning model where instructors tell students what they need to know, *then* assign a problem illustrating how to use those concepts, PBL begins by presenting students with a problem. Students "discover" course concepts and knowledge as they strive to solve the problem. There is evidence that the PBL approach results in richer and longer-lasting learning than does the traditional approach (Brownwell & Jameson, 2004; Miller, 2004; Spence 2001). Anderson and Lawton conducted a series of studies on the use of business simulations as the "problem" for problem based learning. They argued that simulations constitute a form of problem-based learning, given their inherent requirements for the discovery versus the prescription of knowledge. The PBL literature shows strong support for the pedagogy's positive impact on student attitudes. Albanese and Mitchell's (1993) review concluded that "compared with conventional instruction, PBL, as suggested by the findings, is more nurturing and enjoyable." Vernon and Blake also published a review article in 1993 and reported that "PBL was found to be significantly superior [to more traditional teaching methods] with respect to students' program evaluations (i.e., students' attitudes and opinions about their programs). Finally, Colliver's (2000) review found evidence that students may find a PBL approach to be more enjoyable, challenging, and motivating than alternative pedagogies.

Of particular note in Anderson and Lawton's research using simulations in a PBL pedagogy is the relationship between attitudes and performance. As expected based on PBL literature, they found that students consistently rated simulation exercises as enjoyable, engaging, and stimulating over the duration of the course, and they perceived the simulations to reflect the discipline they were studying. Surprisingly, Anderson and Lawton found no support for a relationship between performance on the simulation and enthusiasm for the simulation, the perception of how much was learned, or how well the simulation reflected the discipline. Put simply, students' participation in a business simulation exercise yielded positive attitudes regardless of how the students performed.

This combination of business simulation and PBL literature shows strong support for using a business simulation to achieve positive student attitudes in a course. With respect to attitudes, there appears to be little to risk, and much to gain, from integrating business simulations into business school programs.

Business simulations and psychomotor learning

There has also been research on the behavioral (psychomotor domain) outcomes of using simulations. A number of studies have focused on external validity by comparing success on a simulation with *current* business success (Vance & Gray, 1967; Wolfe, 1976). Others looked at future business success *subsequent to* participating in a simulation exercise. For example, Norris and Snyder (1982) conducted a five-year longitudinal study that found no correlation between company ROI and general game participation measures with career success. However, as noted by Wolfe and Roberts (1986), several "methodological problems could have accounted for the non-correlations found." (p. 47) Wolfe and Roberts (1986, 1993) also examined the external validity of simulations by looking at students' performance on a simulation exercise and their career success five years later. These two longitudinal studies found some association between career success regarding salaries and promotions for students and performance on the simulation. When combined with research design problems noted by the authors, however, these studies offered only minimal support that behaviors exhibited in a business simulation might facilitate later career growth.

Research on behavioral change *during* simulation play has been limited. The most extensive study of this type was by Wellington et al. (1995). They attempted to measure the link between cognitive learning and behavioral learning. They used questionnaires and quizzes after each decision round then monitored the students' decisions in later rounds for behaviors that reflected what they had learned earlier. Unfortunately, the results were mixed. While cognitive learning occurred, the students were not able to consistently translate that knowledge into "correct" decision making behavior.

Schumann, et al. (2001) issued a call for greater research in the psychomotor arena. They noted the paucity of research assessing simulation participants' behavior following completion of the exercise. They hypothesized that a pretest-posttest control-group design that assessed certain student behaviors in subsequent courses could yield insights into the pedagogy's effectiveness in producing behavioral change. They also suggested surveying employers' to obtain feedback on students' behaviors early in their careers. They state, however, that it is unknown whether developing instruments for assessing behavior would be any easier than doing so for learning. While their paper included no empirical support, their suggestions appear to suggest a promising avenue for future research.

Bloom's cognitive learning domain

In 1988, Butler et al. noted that the preponderance of research on what is learned in simulations focused on Bloom's cognitive domain and our review of the literature shows little change since then. Research on the cognitive domain was aided by Gentry and Burns (1981), who provided descriptions of learning and the assessment process for the six levels in the cognitive domain. These descriptions, shown in Table 1, have served as guides for researchers for the past 25 years.

Table 1
Cognitive Domain
Bloom's Taxonomy of Learning Objectives

Learning Objective	Description of Learning	Assessment Process
Basic Knowledge	Student recalls or recognizes information	Answer direct questions/tests
Comprehension	Student changes information into a different symbolic form	Ability to act on or process information by restating in his/her own terms
Application	Student discovers relationships, generalizations, and skills	Application of knowledge to simulated problems
Analysis	Student solves problems in light of conscious knowledge of relationships between components and the principle that organizes the system	Identification of critical assumptions, alternatives and constraints in a problem situation
Synthesis	Student goes beyond what is known, providing new insights	Solution of a problem that requires original, creative thinking
Evaluation	Student develops the ability to create standards of judgment, to weigh, and to analyze	Logical consistency and attention to detail

The focus on the cognitive domain is understandable. As indicated above, the affective domain addresses *feelings* related to learning. While attitude change may be an important concern, it does not demonstrate that learning has occurred, only that those questioned *believe* they have learned. Similarly, while it is of interest whether behavior changes as a result of participation in a simulation, we need to know whether the change was the result of *choosing* to change based on knowledge gained or is due simply to behaviors employed in simulation decision rounds. Until we can determine whether cognitive learning occurred, distinguishing the cause of a behavior change remains elusive. That is, if behavior change is due solely to repeating actions taken in a simulation, transference from a simulation to a business situation is unlikely to be fruitful unless very similar conditions just happen to exist. It is our cognitive comprehension that allows us to adapt what we have learned in one situation to other situations. Lack of an appropriate cognitive foundation seriously inhibits the chances of taking appropriate actions as new situations present themselves.

The cognitive learning outcomes of business simulation exercises

Over the years, researchers have contemplated the state of knowledge about the cognitive learning outcomes that derive from participating in a business simulation (See for example, Brenenstuhl, 1975; Gosen & Washbush, 2004; Keys & Wolfe, 1990; Wolfe, 1985, 1997). This research into simulations has provided insights into attitudes of students and into the relationship of various measures such as GPA, team cohesion, team-building, and group size to simulation performance (Gentry, 1980; Wellington & Faria, 1992; Wolfe, Bowen, & Roberts, 1989; Wolfe & Box, 1988; Wolfe & Chacko, 1983). While this research has contributed to our understanding and use of the pedagogy, we have continued to be very disappointed with how little we can objectively demonstrate regarding what students learn from participating in simulation exercises. As the following will show, while this issue has been studied from the earliest days of simulations, we still are largely unable to document what simulation exercises accomplish regarding cognitive learning. Knowing the educational merits of simulations and other pedagogies would help us select the tools that maximize the learning of our students. However, the sad fact is that we really have very little objective versus attitudinal knowledge of the relative educational merits of case studies versus lecture versus simulations. And, what little knowledge we do have concerning the relative merits tends to be based on assessing educational objectives that fall far down the educational food chain, at the knowledge and understanding levels of Bloom's taxonomy (Burns, Gentry, & Wolfe, 1990; Gosen & Washbush, 2004; Wolfe; 1985, 1997).

Throughout the history of business simulations, researchers have studied their role in the educational process, so an extensive base of publications exists. Fortunately, a series of review articles have distilled the state of our knowledge at several points along the road. This article focuses on these reviews, not simply to present a history of simulation research, but also to show more clearly the progression that has occurred in assessing the efficacy of simulations as a pedagogy. In addition to the review articles, we include a few articles that focus specifically on the relationship between business simulation participation and learning.

An article by Greenlaw and Wyman (1973) was one of the earliest reviews summarizing the learning effectiveness of business simulations. Their work was extended by Wolfe in 1985. These two reviews reached essentially the same conclusion, that the absence of control groups when assessing the wide variety of classroom practices for using business simulations, combined with the range of simulations used, made it very difficult to compare and contrast learning that occurs with simulations. Wolfe best captured the state of knowledge at that time by saying that simulation games "appear to be valid, but much work needs to be done to understand the causes and deterrents of effectiveness" (Wolfe, 1985: 275). Employing Bloom's Taxonomy of Learning Objectives (1956) as a means for classifying learning outcomes, Wolfe found a dearth of assessment of learning at the higher levels on Bloom's Taxonomy in the studies he reviewed.

Building off of Bloom's Taxonomy of Learning Objectives used by Wolfe (1985) and others, Hsu (1989) moved the call for critical analysis into sharper focus. He clarified the need to distinguish between "declarative knowledge" and "procedural knowledge". The former deals with "a passive mastery of information" while the latter refers to "gaining information or knowledge and acquiring practical skills in applying that knowledge through performing tasks" (Hsu, 1989: 414). In an attempt to incorporate Bloom's three domains of cognitive, affective, and psychomotor learning, Hsu proposed a four-phase learning process that consisted of 1) retaining information, 2) organizing knowledge, 3) experiencing, and 4) firming. He used these phases to identify tools and methods for assessing learning and then applied this model to management education and business simulations. Finally, Hsu categorized the research reviewed by Greenlaw and Wyman (1973) and Wolfe (1985), finding little support for the effectiveness of playing management games. To achieve success at demonstrating support for the pedagogy's effectiveness, he called for having "clear and specific hypotheses on the specific learning objectives" which target managerial, technical, and problem-solving skills (Hsu, 1989: 433).

Shortly after Hsu's article appeared, Keys and Wolfe (1990) published an extensive review analyzing the various dimensions of simulation research. They reviewed studies conducted to assess the relationship between participants' performance on a business simulation exercise and variables such as team size, team composition, the simulation's face validity, number and frequency of decision rounds played, instructor involvement, and student aptitudes and achievement levels. While this review provided valuable insight into variables that might influence performance on the simulation, the objective measures used to measure learning were limited to comprehension of simulation rules and course facts, the lower levels on Bloom's cognitive domain. As with the vast majority of simulation studies, objective assessments of learning at the higher stages of Bloom's Taxonomy (1959) were absent.

At the same time, Burns, Gentry, and Wolfe (1990) summarized the literature on business simulations by stating there was a "paucity of solid empirical evidence regarding the relative effectiveness of experiential techniques" (p. 253). They pointed out that 1) too many simulation users rely on the enthusiasm of their students and own intuition as proof of the validity of the pedagogy and 2) the wide variety of methodological constructs used as the foundation for research in this area raises questions regarding internal and external validity. They argued that until some measure of external validity is established, it is unclear whether what we learn from experimental exercises can be generalized and transferred to success in the working world (pp. 256-258). Put simply, they found an absence of rigorous research supporting the learning effectiveness of experiential methods such as business simulations.

Gosenpud (1990) conducted a review of the effectiveness of business simulations, as well as other experiential exercises. He cited the lack of rigor as a major problem mitigating the conclusions reached in the studies. Gosenpud found studies that reported cognitive learning, but they either were based on *perceptions* of learning or they assessed the lower levels of the learning domain. The studies Gosenpud cited for assessing behavioral change/skill acquisition (the psychomotor domain) either suffered from ill-defined criterion measures or, again, were based on *perceptions* of behavioral change.

Wolfe (1990) also conducted an extensive review of over 300 articles covering three decades to assess "what is known about the efficacy of business games" (p. 280). He organized the review based on categories used by Burns, Gentry, and Wolfe (1990) including such variables as game complexity, team size, student attributes, and educator considerations. Wolfe found numerous studies purporting to show the effect of these variables on game performance. Unfortunately, he concludes "game performance has been employed as a proxy for course-related knowledge gain, although the accuracy of this proxy relationship has never been investigated" (p. 299).

Prompted by Wolfe's assessment, Anderson and Lawton (1992) conducted a study to test directly the relationship between game performance and a series of learning measures. They assessed the performance of students on seven course assignments (e.g., two annual business plans, a scenario exam, and assignments on specific simulation decisions such as conducting a cost/benefit analysis on plant expansion). The assignments were designed to measure learning at the various stages in Bloom's cognitive domain. They did not find a significant relationship between financial performance and the various measures of learning, except for the two annual business plans. As Anderson and Lawton noted, this raises questions about using financial performance as a proxy for learning on a simulation exercise.

In 2001, Faria provided a review of "the changing nature of business simulation/gaming research." While he explicitly stated his intent was not to update the review by Keys and Wolfe (1990), the article did report on the status of research into the effectiveness of business simulation at the time of its publication. As part of his review, Faria categorized the research he reviewed into cognitive, affective, and behavioral learning, following Bloom's Taxonomy of Learning Objectives (1959). While Faria found support in the literature for cognitive learning, the learning involved "basic facts or concepts" (p. 104), which are the lower levels of learning on Bloom's Taxonomy. Objective support for the higher levels of the cognitive domain was absent. Faria found support for affective learning, reporting not just the participants' positive attitude toward the simulation and its role in their perceived learning at the end of the experience, but also years later. However, Faria also points out that affective learning is, by its inherent nature, based on the *perceptions* of the simulations' participants, not objective assessments. As for behavioral learning resulting from simulation exercises, Faria states that "research results attempting to measure behavioral change have been mixed" (p. 105).

In the same year that the Faria review was published, Washbush and Gosen (2001) reported the results of a series of studies they conducted with total enterprise simulations. These studies encompassed nine hypotheses related to simulation-based learning. They included testing the relationship between learning and variables such as participation in a simulation exercise and performance on that exercise. Two of their conclusions are pertinent to this review: 1) there is evidence that learning occurs as a consequence of participating in a simulation exercise and 2) there is a lack of support for a relationship between learning and performance on the simulation. While Washbush and Gosen did find evidence that participation in a simulation exercise resulted in learning, they measured learning using multiple-choice and short essay questions. While not stated as such by Washbush and Gosen, their measures of learning appear to be targeted at the lower levels of learning on Bloom's cognitive domain. Concerning the second conclusion (that there is no support for a relationship between performance and learning), Washbush and Gosen point out this is consistent with the findings of Anderson and Lawton (1992).

More recently, Gosen and Washbush (2004) conducted a review of research to assess the effectiveness of business simulations on learning. They concluded that performance on a simulation exercise should not be used as a proxy for learning. Perhaps more importantly, Gosen and Washbush found that "none of the 115 studies considered for this article met all the criteria for sound research" (p. 283). They went on to state that "learning is an internal mental process, and what is learned and how it is learned is unique to each individual" (p. 284). This statement would appear to capture the essence of the learning assessment debate. Gosen and Washbush conclude that the lack of rigor in the research, which is a consequence of our limited ability to assess higher level learning, precludes a clear answer to this question.

Finally, Wideman et al. (2007) addressed the contention that participating in simulations results in learning. They argued that, although research has supported the educational value of this pedagogy, the research is deeply flawed. They contend that studies have largely relied on the self-reports of teachers and students. They state that the absence of valid objective measures for assessing learning hampers the ability to draw any meaningful conclusions regarding a simulation's effect on learning; support for the educational impact of simulations is subjective, at best.

The current state of assessment of cognitive learning and business simulations

To summarize the current state of the research on efficacy of business simulation for achieving cognitive learning outcomes, it is safe to say that little has changed since Wolfe's admonition in 1985 that that simulation games "appear to be valid, but much work needs to be done to understand the causes and deterrents of effectiveness" (p. 275). Twenty years later, Gosen and Washbush (2004) come to essentially the same conclusion, stating "there have not been enough high-quality studies to allow us to conclude players learn by participating in simulations" (p. 286). Objective measures of learning are still limited to the basic knowledge, comprehension, and application stages of cognitive learning. Attempts to measure analysis, synthesis, and evaluation stages have continued to be limited to self reports – participant perceptions of their improved abilities. We have a long way to go to provide objective evidence of the learning efficacy of business simulation exercises for the higher levels on Bloom's Taxonomy for the cognitive domain.

While a review of the literature on simulations shows its positive effect on the attitudes of participants, its efficacy regarding cognitive learning yields a gloomy picture. When we reflect on our knowledge of what simulations accomplish, the overwhelming conclusion is that we know very little. The principal reasons why we know so little are quite clear and have been for quite some time. First, the studies conducted to examine what students learn from simulations have been based largely on perceptions of learning rather than some more objective standard; a flaw that has been repeatedly pointed out for over twenty years – see, for example, Anderson & Lawton, 1992, 1997; Burns, Gentry, & Wolfe, 1990; Gosen & Washbush, 2004; Wolfe, 1985, 1997. Second, where objective assessments have been attempted, they almost invariably focus on the lower levels of Bloom's Taxonomy of cognitive learning – and this shortcoming too has been noted repeatedly in the review articles cited above.

There are occasions where perceptions are perfectly fitting and there are instances when measuring the lower levels of Bloom's Taxonomy is appropriate. But we should be clear about where these cases lie. If we are attempting to determine whether a pedagogy is successful in improving attitudes toward learning in our course or toward a discipline, it is appropriate to measure student perceptions – in fact, we have little alternative other than perceptions. However, if we are attempting to measure dimensions of learning such as knowledge of vocabulary, understanding of principles, understanding of the relationships among principles or disciplines, or the ability to apply principles, then measuring perceptions is unlikely to be very useful.

Measuring at the lower levels of Bloom's Taxonomy is fitting if we really wish to test whether students have basic knowledge or comprehension. For example, many instructors give short tests early (these tests often are provided in the instructors' manuals accompanying simulations) to see if students have sufficient understanding of the rules and the business environment to compete effectively. Since the goal is to determine the student's level of knowledge, we should employ a test that *measures* their level of knowledge. However, if we are interested in whether students are performing well at a higher level learning, then tests of knowledge and comprehension alone are inadequate, and we need to use tests or other direct measures of learning that require analysis, synthesis, and evaluation.

If the collective wisdom of long-time simulation users is correct, simulations are better at conveying higher levels of learning while, for example, the lecture method is likely to be more efficient at the lower levels. If this is true, measuring at lower levels on Bloom's taxonomy is likely to result in undervaluing simulations.

This lack of knowledge of learning outcomes is not unique to simulations; we might ask what objective evidence has been offered demonstrating that lectures, case discussions, or any other pedagogy are able to achieve Bloom's higher level cognitive learning objectives. While the literature on business simulations may be replete with statements lamenting over-reliance on perceptions and anecdotal evidence, is the situation any different from that supporting any other pedagogy?

The issue of assessing the relative educational power of alternative pedagogies may be more salient for simulations than say lectures because simulations are relative newcomers to the educational scene. Because the lecture method has tradition that dates back centuries and because it is so prevalent, educators feel little need to justify the use of the pedagogy. The more recent the introduction of a pedagogy, the greater the pressure to justify its value. Further, as noted above, simulations' time utilization relative to other pedagogies often raises questions regarding its efficiency for imparting learning. The bottom line is that while greater focus has been placed on the educational outcomes of simulations than of most alternative pedagogies, this should not be interpreted as evidence that simulations are weak tools; more likely it reflects their relatively recent introduction as a pedagogy.

Are we capable of assessing the cognitive learning in simulations?

As Wolfe and Crookall stated in 1998, "The impediments to conducting educational research that is useful and practical to those who teach are numerous and are associated with the field of educational research in general and with the nature of learning in simulation/gaming contexts more specifically." (p. 9) While these impediments pose obstacles to implementation, we do now have a good idea of what must be done to compare the effectiveness of pedagogies.

To compare the cognitive learning of alternative pedagogies, we must 1) clarify the domain in Bloom's Taxonomy and the states within that domain that we are trying to assess (e.g., knowledge, applications, evaluation), 2) employ appropriate assessment instruments, and 3) design and execute appropriate studies. Having a clear understanding of the specific "educational value" that we are trying to assess should influence the domain we measure as well as our choice of a measurement instrument.

As noted above, to improve our state of knowledge we should use student perceptions as our dependent variable only when we are concerned with attitude change. In order to move forward, we must develop and use more objective measures when we wish to assess learning in Bloom's cognitive domain.

Assessment tools

If the educational value that we are attempting to assess is something other than attitudes, we have a large number of assessment tools from which to choose. As has been amply pointed out in the literature, our ability to measure lower levels of learning (knowledge and comprehension) tends to be considerably better than our ability to measure higher-level learning (synthesis and evaluation), but if we are clear on our learning objectives, we should be able to identify appropriate tools. By nature, some instruments are better suited to measuring lower levels of Bloom's taxonomy of learning (for example, multiple choice exams) while others are more appropriate for higher levels of learning (for example, case-based exams). Anderson and Lawton (1988) provided a good discussion of alternative assessment tools to use for assessing the different levels of the cognitive domain, identifying the strength of each (strong, medium, weak) for measuring each level. Gijbels et al. (2005) also offered suggestions in this regard; they discussed the potential of a number of assessment instruments for measuring different levels of learning. These include modified essay questions, progress tests, free recall, standardized simulations, essay questions, short-answer questions, multiple-choice questions, oral examinations, performance-based testing, case-based examinations, and synthesizing research. So, multiple tools are available if we choose to use them.

Regarding assessment tools, a legitimate question arises as to whether any of these instruments is sensitive enough to measure the gains achieved with *any* pedagogy. It is one thing to measure whether a student has added a vocabulary item or can understand a new concept, but quite another to assess whether the student has improved his ability to solve problems that require original, creative thinking. When viewed in the context of a student's lifetime spent as a problem-solver, can we reasonably expect any instrument to be so sensitive as to be able to detect the impact of a single experience such as a simulation, or even an entire course?

So, while we have assessment tools that can be employed to measure higher-levels of learning, and while these instruments have undoubtedly been underutilized (in favor of instruments that measure the lower levels of Bloom's taxonomy), we may question how many educational experiences are powerful enough to produce measurable improvements for the higher levels of learning.

Research design

We know how to design studies to compare the relative merits of alternative pedagogies. We all are well aware that anecdotal evidence and observational studies provide weak evidence for the relative efficacy of alternative pedagogies (Butler et al., 1988). To provide valid substantiation for the power of a pedagogy requires rigorous experimental design.

To meet these conditions, students should be assigned to alternative treatments randomly. However, at most institutions students have obligations both within the institution (such as other classes) and outside the institution (such as work schedules and family responsibilities) that make random assignment almost impossible. In addition, it is very difficult to hold conditions constant to isolate the effect of the treatment. One of the largest potentially confounding factors is the instructor. There are two obvious paths to control for the impact of the instructor, but both pose practical difficulties. One path to tackle the problem is to hold the instructor constant by having the same instructor use different pedagogies in different sections of his or her course. The problems with this approach include: 1) the instructor must be teaching multiple sections of the same class; 2) the number of students in the sections must be sufficiently large to make the test feasible; 3) the instructor must be willing to devote the time and effort to teach, prepare, and present the course in two different ways. The bias and relative competence of the instructor also may pose problems. If the instructor is more enamored, more comfortable, or more proficient with one of the pedagogies being used, it is likely to put the other pedagogy at a distinct disadvantage.

The second path to controlling for instructor effect is to have a large pool of instructors and to randomly assign them to using different pedagogies. Obtaining the participation of a pool of instructors and coordinating their activities poses real challenges. The rewards for participating faculty members are likely to be slim. Even if a publishable paper comes out of the study, the number of co-authors is likely to diminish the value of the publication for any of the participants in the eyes of their institutions.

There is an ethical dimension to pedagogical research that adds yet another impediment to implementation. If an instructor firmly believes in the educational superiority of one pedagogy over another, is it ethical to use a perceived inferior pedagogy for the sake of potentially advancing knowledge of that pedagogy's worth? The situation educators face is much like that in medical research where some patients are given placebos rather than active treatment; while there may be long-term benefits, in the short run some patients (and likewise some students) are likely to suffer.

Problem based learning and cognitive learning outcomes

As discussed earlier, Anderson and Lawton (2005, 2006) argued that business simulations constitute a form of problem-based learning (PBL). If they are correct, then the problem-based learning literature should shed light on the learning outcomes of business simulations. That is, if the PBL literature shows objective assessment of that pedagogy's efficacy for achieving learning outcomes, that evidence provides tangential support for the efficacy of simulations as well.

Gijbels et al. (2005) published an excellent review on the status of assessment of PBL. The central question that they addressed was whether students achieve learning outcomes more effectively under a PBL pedagogy than under conventional pedagogies. Unfortunately for our purposes, the authors did not adopt Bloom's Taxonomy as their framework for approaching this question. Instead, they used Sugrue's (1995) model on the cognitive components of problem solving. This model uses three levels of knowledge structure to classify the studies they reviewed. These levels are 1) the understanding of concepts, 2) the understanding of the principles that link concepts, and 3) the linking of concepts and principles to conditions and procedures for application (Gijbels et al., 2005, p. 44). Although Sugrue's model certainly differs from Bloom's Taxonomy, his first level (understanding the concepts) relates to students' ability to identify and classify material to which they have been exposed. This level clearly coincides with Bloom's lowest level of Basic Knowledge. Sugrue's second level (understanding of the principles that link concepts) is concerned with students' ability to organize concepts and ideas in a meaningful way. If a student is operating at this second level, he or she can use principles "to interpret problems, to guide actions, to troubleshoot systems, to explain why something happened, or to predict the effect a change in some concept(s) will have on other concepts." (Sugrue, 1993, p. 9) This second level appears to contain elements of Bloom's Comprehension level and possibly the Application level. Sugrue's highest level (and linking of concepts and principles to conditions and procedures for application) concerns the ability of the student to apply the organized set of principles to solve problems. This third level arguably corresponds with Bloom's Application level and possibly the Analysis level.

The literature and insights gained on PBL could yield synergistic insights and directions for future research for simulations. For example, the Gijbels et al. (2005) review found that PBL was most effective when assessing understanding the principles that link concepts – Sugrue's second level of knowledge and, by extension, perhaps Bloom's Comprehension and Application levels. Their review also found some indication that PBL produced better results for Sugrue's highest level of the knowledge structure, although the difference was not statistically significant. Gijbels et al. point out that a shortcoming of their review is that despite an exhaustive effort to find studies across a broad range of disciplines, all but one of the studies that met their criteria for inclusion in their review came from medical education. Regardless, the conclusions are reasonably consistent with the prevailing wisdom on the benefits of business simulations. These results suggest that there may be opportunities for future research in the PBL field that can provide objective evidence on its efficacy for achieving learning outcomes at the higher levels of knowledge that can apply to simulations.

Are we likely to do it?

Almost no experimental studies exist that compare learning outcomes under alternative pedagogies. Interestingly, Wolfe (1990) identified this problem nearly twenty years ago, yet the gap still exists. The obstacles to designing and conducting experimental studies in a university setting may initially seem daunting.

We might speculate as to why so little progress has been made in *objectively* assessing the cognitive learning that occurs in simulations. It is our opinion, echoed by Gosen and Washbush (2004), that perceptions are widely used because they are easily measured. So, despite the repeated call for greater rigor in measuring learning, we have made little headway on this front. Researchers continue to use self-assessments rather than more suitable tools because they are much easier to employ. As a consequence, studies on the educational merits of simulations often are measuring the affective domain, not the cognitive domain they purport to measure.

Using perceptions tends to be advantageous in some ways to those who wish to claim the superiority of simulations over alternative pedagogies because simulations almost invariably are rated positively by students. The downside of using perceptions is that evidence based on perceptions often is dismissed by scholars because it lacks suitable rigor.

Studies that attempt to go beyond perceptions to more objective measures of learning more often than not use tools best suited to measuring lower levels of learning on Bloom's taxonomy. We believe this bias toward instruments that measure at the lower levels exists for several reasons: 1) We have a better understanding of how to measure the lower levels than how to measure the higher levels and 2) measuring at the higher levels requires designing and executing tools that require greater time and effort to construct and to score. Given the many publication and service pressures on faculty members, there is a bias against using more appropriate instruments. As noted by Gosen and Washbush (2004) there is little payoff for expending the effort to design and execute the rigorous research designs needed to pursue assessment at these cognitive levels. Pedagogical research studies may naturally be valued in schools of education, but they generally are accorded little worth in business programs, especially at major research institutions where discipline-based research is favored, if not required.

Efforts to improve our knowledge might also be handicapped by faculty evaluation systems. Utilizing different pedagogies between course sections for the same instructor runs the risk of student complaints of unequal workloads and protestations of using students as guinea pigs while putting their education at risk.

Few instructors are willing to run this risk when tenure and promotion decisions are influenced by student evaluations.

Further, Serva and Fuller (2004) argue that the poor state of teaching evaluations in universities has serious implications for improving teaching effectiveness and student learning. Their concern is that teaching evaluation instruments neither reflect changes in the use of technology in education nor new delivery modes such as distance education. They argue that the misalignment of the evaluations system and educational environment results in instructor reluctance to test new learning techniques or technologies. If this is true, then instructor willingness to experiment with pedagogical designs to test for their effect on learning outcomes will also likely be suppressed.

In summary, even though we know how to assess the educational impact of alternative pedagogies, the barriers to implementation may seem so high that most likely little will be done. The effort required relative to reward achieved is such that we are likely to see continued reliance on descriptive studies using student perceptions as the dependent variable. The pressures on instructors to publish and to participate in service activities make rigorous research to measure upper level learning outcomes unattractive.

Is there any hope?

While the situation may appear grim, there are some developments occurring in the profession that may result in improved assessment of the educational impact of simulations.

New technology for measuring learning

Wideman et al. (2007) propose a vehicle for getting beyond the reliance on self-report measures of the learning achieved on simulation exercises. They report on an exploratory study of a software program (VULab) designed to collect data from simulation participants as they engage in the exercise. Online data collection is employed to minimize intrusion into game activities. In some cases, the data collected are a combination of screen activity synchronized with audio of player discussion. Wideman et al. contend these recordings, combined with questionnaires, can be coded using qualitative software analysis such as Atlas.ti v5, as described by Pandit (1996). While Wideman et al. experienced a number of technology problems, the methodology appears to hold some promise as a means for obtaining data other than perceptions. They claim this approach may allow for measuring students' comprehension of course concepts and assessment of their evaluative skills, providing insights into the higher levels of cognition on Bloom's Taxonomy.

Distance learning

Distance learning may offer a venue in which we can measure the educational value of alternative pedagogies. Since students are not together in a classroom, instructors have the ability to set up true experimental conditions far more easily than in traditional classrooms. For example, one set of randomly assigned students could be assigned a set of cases while, at the same time, in the same course, with the same instructor, a second set of students could be assigned to participate in a simulation. The two groups of students could be assessed using the same assessment instrument to see how their learning compares.

Of course, using distance learning courses as a laboratory presents a set of problems of its own. It may be necessary to modify (or it may not even be feasible to use) some pedagogies commonly used in traditional classrooms (like role playing exercises and lectures) in a distance learning environment. A further issue arises concerning the ability to generalize the results of an online experience to a traditional classroom setting. It may well be that the methods that are most effective for online learning differ from those that are most effective for in-class learning.

AACSB accreditation pressures

As business programs seek to pursue or maintain AACSB accreditation, one of the challenges they face is developing and implementing Assurance of Learning measures (AoLs). By their nature and design, theses AoL goals typically seek to assess students' business skills beyond just knowledge of business disciplines, but also their ability to analyze, synthesize and evaluate – the upper levels of Bloom's Taxonomy. If simulation users *and providers* wish to utilize simulations in this process, they will have to develop the objective evidence needed to convince accreditation committees of the pedagogy's efficacy for assessing cognitive learning.

Earlier we identified some barriers to researchers undertaking the rigorous studies needed to provide this validation. Perhaps the "carrot" of seeking accreditation or the "stick" of maintaining accreditation will offer a sufficient incentive to take on the burdens inherent in this research. Given the potential financial payoff for a simulation provider, the availability of funding of this research may attract researchers into undertaking this effort. The bottom line is that we must continue our journey toward effective assessment of the value of simulations vis-à-vis other pedagogies. As Wolfe and Crookall state, "meaningful educational research must be conducted if we are to create identifiable value for (a) those exposed to our methods and (b) those who underwrite and fund our work." (1998, p. 13)

Financial pressures

Finally, it is possible that a perfect storm may drive the profession to conduct a rigorous assessment of the worth of alternative pedagogies. There seem to be at least three converging forces that may motivate educational institutions and funding agencies to allocate the resources required to conduct a rigorous analysis of the educational merit of pedagogies: 1) the emphasis on assessment throughout all levels of education; 2) the rapidly escalating costs of higher education; and 3) the competition from alternative educational delivery systems. Educators in traditional brick and mortar institutions may feel pressure to justify their high cost while online alternatives may feel compelled to strive for legitimacy. The route for those in both camps to validate their case is to provide results of well-designed research studies demonstrating the educational value of the education they provide. If sufficient resources are made available to educators, the inertia that has characterized this field may be overcome.

Future directions

Simulation scholars have attempted to determine whether simulations accomplish what instructors hope to achieve through the use of this pedagogy. However, several of these topics outlined at the beginning of this paper have received almost no attention. The following topics appear to be fertile areas for research because there is virtually no existing literature: Does participating in a simulation result in better (than if the student is exposed to the material through other pedagogies) long-term retention of knowledge? Do students improve their grasp of the interrelationships among the various functions of business (marketing, finance, production, etc.) as a result of participating in a simulation? Are the interpersonal skills of students improved through participating in a simulation? Do students who participate in simulations really develop a greater appreciation for the difficulty of implementing what may, on the surface, appear to be rather straightforward business concepts? Are business simulations really effective devices for integrating students into business programs and are they effective at improving retention rates?

Integration and retention

This last issue deserves some additional comment since it is not frequently cited. Some faculty have discovered that the interactive nature of simulations make them ideal ice-breakers and team-building exercises. Although no published studies exist, it is entirely possible that judicious use of simulations may increase retention rates in business programs. There is a body of literature to support the contention that students who fail to become academically and socially integrated into academic programs are at high risk for dropping out of their programs. (See, for example, Ashar & Skenes, 1993; Astin, 1993; Tinto, 1993) Group exercises like simulations that force interaction and cooperation among students appear to hold considerable potential for helping students to become integrated.

Distance learners are likely be particularly vulnerable group because they rarely have the opportunity for face-to-face interaction with their peers. The resulting sense of isolation is likely to be a major contributing factor for the high dropout rate among distance learners, which is worse than that for students in traditional, on-campus programs (Carr, 2000). Nitsch (2003) states that "[distance education] students need some form of socialization in order to feel like they are part of the institution. Even though they do not live on campus, they need strong ties to the academic culture and peer learners." Kennedy and Lawton (2007) "have used a business simulation with success as a device for integrating master's level students into an online master's level program. While simulations are not panaceas for the problems facing distance education programs, if used well, they can incorporate many elements [that have proven successful in increasing retention rates]." However, at this point hard data to support this application of simulations are virtually nonexistent.

A final comment

We have learned much regarding the efficacy of simulations for promoting learning (cognitive, affective, psychomotor) over the past 40 years, but we still have much to learn and there are many avenues of research worth pursuing. While seeking answers to the question of cognitive learning that occurs as a consequence of the use of simulations is important and needs to be investigated, the questions posed regarding future research also merit attention. Simulation scholars may feel daunted by the challenges we face. However, we must keep in mind that demonstrating the learning effectiveness of a pedagogy is a task we do not face alone. As technology advances and as new pedagogies emerge, attention inevitably will be focused on assessing the educational worth of the alternatives. It is inconceivable that any one study will provide the definitive answer to the efficacy and the place in the educational landscape for each pedagogy. So, it is imperative that we continue to take baby steps toward increasing our understanding.

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