



Simulation-based learning in management education

A longitudinal quasi-experimental evaluation of instructional effectiveness

Received 16 November 2011
Revised 21 July 2012
Accepted 10 August 2012

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Abstract

Purpose – Proponents have argued that simulation-based learning (SBL) offers capabilities that respond to persisting critiques of management education. This research intended to provide additional empirical evidence for the instructional effectiveness of SBL. This paper aims to discuss these issues.

Design/methodology/approach – This research adopted a quasi-experimental, multiple time series design to examine the instructional effectiveness of courses that incorporated computer simulations in a Master of Management program at a business school in Thailand. It compared student perceptions of three SBL courses with courses that used a variety of other instructional approaches over a period of seven years.

Findings – Results revealed that students rated the SBL courses significantly higher on overall perceived instructional effectiveness, as manifested by action-directed learning, student engagement, quality of assessment and feedback, and instructor effectiveness.

Research limitations/implications – The consistency of significant results for a large number of course sections over a substantial period of time suggests that the SBL courses created a more active, productive environment in which to learn management theory and practice.

Practical implications – The results support assertions that simulations offer potential for enhancing the quality of university-based management education.

Originality/value – First, the research provides empirical insights into the implementation of SBL in management education; second, many instructors remain skeptical as to whether active learning methods imported from western contexts are suitable for Asian learners. The study addresses this issue in the light of data that describe one institution's sustained attempt to employ computer simulations in its graduate management education program.

Keywords Management education, Simulation-based learning, Multiple time-series design, Student evaluation

Paper type Research paper



In recent years, graduate education in management has come under fire from a wide range of influential scholars (e.g. Bennis and O'Toole, 2005; Mintzberg, 2002;

Pfeffer and Fong, 2004). Critics have identified three persisting problems related to the design and delivery of higher education programs in management:

- (1) the curriculum is dominated by academic disciplines and often disconnected from management practice (Hallinger and Bridges, 2007; Buckley *et al.*, 1992; Kloppenborg and Baucus, 2003);
- (2) learning is largely teacher-directed, often resulting in limited student engagement and transfer of knowledge beyond the classroom (Bridges, 1977; Garvin, 1991; Pfeffer and Fong, 2004); and
- (3) the curriculum emphasizes analysis and calculation with limited attention to the development of affective, moral, and problem-solving skills necessary to gaining results with and through other people (Hallinger and Bridges, 2007; Bennis and O'Toole, 2005; Bridges, 1977; Mintzberg, 2002).

Over the past 25 years, the demand for graduate education in the professions to meet increasingly ambitious goals has led to increased experimentation with different approaches to teaching and learning. Among these, simulation and games, used as long ago as the 1950s, have become increasingly common in management education programs (Hallinger and McCary, 1990; Cohen and Rhenman, 1961; Faria, 2001; Lean *et al.*, 2006; Raia, 1966; Salas *et al.*, 2009; Scherpereel, 2005; Slotte and Herbert, 2007). While proponents continue to offer a strong conceptual rationale for the use of simulation-based learning (SBL), high quality empirical studies that examine its efficacy in management education settings remain limited both in number and quality (Bell *et al.*, 2008; Cook and Swift, 2006; Faria, 2001; Salas *et al.*, 2009; Scherpereel, 2005; Steadman *et al.*, 2006).

This report describes a longitudinal quasi-experimental evaluation of SBL at a graduate school of business (GSB) in Thailand. The "intervention" consisted of three courses in the GSB's Master of Management program that incorporated computer simulations. These courses were taught 202 times by 22 different instructors over a period of 20 consecutive trimesters between 2001 and 2007. This report compares student perceptions of instructional effectiveness in the SBL courses with courses that employed a variety of other instructional approaches.

This study seeks to make three contributions to the literature. First, the research provides empirical insights into the implementation of SBL in management education. Second, although the study does not measure impact on student learning outcomes, the results speak to the efficacy of SBL with respect to dimensions of teaching and learning that both mediate learning and are valued by management students. In the market-driven environment of management education, student perceptions must be taken as one – though certainly not the only – valid criterion of instructional effectiveness. Finally, we note that this research on SBL was conducted at a management education program located in East Asia. Although East Asia represents one of the most rapidly growing geographic sectors of management education, many instructors in the region remain skeptical as to whether active learning methods imported from western contexts (e.g. simulations, problem-based learning, etc.) are suitable for Asian learners (e.g. see Kember, 2000; Walker *et al.*, 1996; Watkins, 2000). The study addresses this issue in the light of data that describe one institution's sustained attempt to employ computer simulations in its graduate management education program.

Theoretical background and research focus

In this part of the paper we present conceptual background on SBL. We begin by defining SBL and discussing how this instructional method has been used in

management education. In the second section, we discuss the specific focus of the study and present our research hypotheses.

SBL

Proponents have argued that SBL is closely aligned to several important goals of management education (Hallinger and Bridges, 2007; Adobor and Daneshfar, 2006; Salas *et al.*, 2009; Steadman *et al.*, 2006). These include enhancing complex applied competencies in decision making and teamwork, fostering skills in higher order thinking and reflection, and learning to use knowledge as a tool for problem solving (Bransford, 1993; Bransford *et al.*, 2000; Gary and Wood, 2011; Kimber, 1996; Mintzberg, 2002; Rosen *et al.*, 2008; Salas *et al.*, 2009; Scherpereel, 2005). Simulations represent one instructional method with the potential to overcome the problem of “analysis paralysis” that can emerge when learning skills and perspectives on professional practice in an academic institution (Bridges, 1977).

Well-designed computer simulations create a form of “virtual reality” that allows students to learn, apply, and refine job-relevant knowledge and skills (Bell *et al.*, 2008). The computer simulations discussed in this study engage students in solving high fidelity, complex, dynamic management problems. To succeed in the simulations, students must understand and define the problem(s), surface individual and collective assumptions about the problem and its context, consider practical as well as theoretical constraints, and internalize theory-derived principles into mental models that guide their actions (Hallinger and Bridges, 2007; Gary and Wood, 2011). In sum, the simulations require students to “situate knowledge in a problem context” and consider the contingencies that impact the application of both formal and tacit knowledge in management practice (Wagner, 1993).

Well-designed computer simulations also create a cost-effective, fun learning environment. In management simulations, the organizational context for action evolves in response to decisions made by students over a period of “simulated time” (e.g. in the simulations discussed in this paper from one to three years). Students employ budgeted resources (e.g. money, time, staff knowledge) toward the achievement of specific goals (e.g. increased productivity, sales, market share, implementation of an innovation). Through the simulated experience, students are able to see how organizational processes unfold over time. In a period of hours they have the opportunity to gain a perspective on organizational events that would otherwise require years of “real time” working experience.

We further note that commonly used management simulations are often played in a team learning environment. The simulated problem solving typically entails intensive interaction in decision making. As with any learning environment that seeks authenticity, team members experience a full range of emotional states including engagement, excitement, challenge, frustration, conflict, joy, consternation, surprise, disappointment, pride, and satisfaction. This contrasts with the overtly dispassionate, analytical mode of learning that often typifies students’ experience of graduate management education (Bridges, 1977; Mintzberg, 2002). We also highlight these features of the learning environment because they contrast so vividly with the image that comes to mind when people usually think of traditional computer-based instruction.

The instructional mode, sequence, and duration of delivery varies for different instructors, learning settings, and computer simulations. However, the dynamic complexity and rich content embedded in computer simulations often make them suitable as a core activity for inclusion in a university course. An example of the

instructional flow for a SBL unit is presented in Figure 1. The instructor begins by presenting students with the problematic situation which serves as the initial stimulus for learning (Bridges and Hallinger, 1999; Hallinger and Bridges, 2007; Salas *et al.*, 2009). Student teams review the problem, identify relevant resources, develop learning gaps and goals, formulate an initial diagnosis of the problem, and formulate an initial strategy for solution. Students then engage in implementing their solution and observing the responses. Periods during which learners “play the simulation” are interspersed with instructor-led debriefings, or mini-lectures, online discussion among players, and reading.

Much like the use of simulated patients in problem-based medical education (Barrows, 1993), management simulations provide students with an “evolving, interactive, and dynamic problem space” in which to learn (Bridges and Hallinger, 1999; Hallinger and Bridges, 2007; Bransford *et al.*, 1989). The initial problem and related contingencies change over time in response to student decisions. This contrasts vividly with most teaching cases in which learners “enter a problematic situation” that remains a stable as the learners develop their solutions.

This dynamic interactive feature of SBL creates a strong impetus for students to employ creativity, analytical reasoning, and problem-solving skills (Bransford, 1993; Bransford *et al.*, 1989). Prawat (1989) has suggested that adopting a problem-solving mentality, even when it is marginally appropriate, reinforces the notion that the knowledge is a useful tool for achieving particular goals. Students are not simply being asked to store information, but to examine how it is applied in particular situations. This increases accessibility of the knowledge when needed in the future, and enhances both retention and transfer of learning (Bransford, 1993; Bransford *et al.*, 2000; Wagner, 1993).

When playing a well-designed simulation, students will seldom experience exactly the same pattern of events twice, even when they employ the same strategy[1]. This contingent, dynamic feature of the learning environment stimulates learners to reflect on cause and effect relationships with respect to their strategic decisions and rethink their “mental models” (Hallinger and McCary, 1990; Gary and Wood, 2011; Scherpereel, 2005). Faced with a complex problem situated in a specific organizational context, students begin to develop a mindset of learning from mistakes, and cease looking for “one right answer” (Hallinger and McCary, 1990; Hallinger and Bridges, 1997; Alter *et al.*, 2007; Gary and Wood, 2011; Salas *et al.*, 2009). Moreover, they focus on learning principles of application rather than simple facts or a sequence of steps.

Our own design of SBL instructional units rests on six elements:

- (1) presentation of a high fidelity, authentic problem;
- (2) theory-informed decision rules embedded in the simulation program;

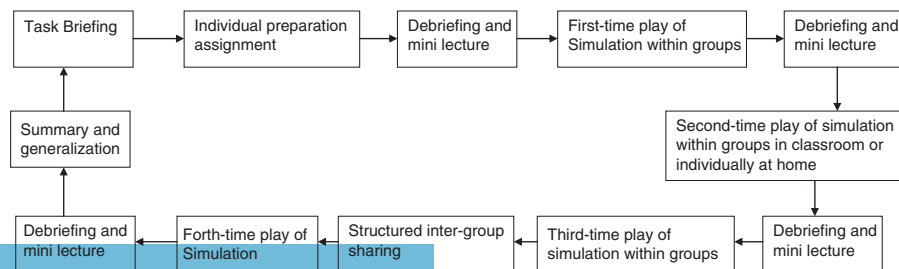


Figure 1.
Exemplary flow of
a SBL course

- (3) use of cooperative learning teams;
- (4) provision of relevant knowledge resources;
- (5) development of a solution product that demonstrates the learners' capacity to solve the problem taking into account both formal and tacit knowledge; and
- (6) provision of multi-faceted assessments and timely feedback (Hallinger and Bridges, 2007).

These design elements cohere to create a challenging learning environment that engages students, directs their learning toward the solution of meaningful problems, and offers a continuous stream of corrective feedback and reflection.

Research focus and hypotheses

This study sought to examine the relationship between SBL and student perceptions of instructional effectiveness in a graduate management education program in Thailand. Student evaluations of instructional effectiveness are a useful source of feedback on results for education institutions (Aleamoni, 1999; Kraiger, 2002; Scriven, 1988). Students who attend graduate management programs tend to be goal-directed and career-oriented with desires both to complete the program successfully and learn useful content (Watkins, 2000). Particularly in fee-paying universities, students tend to be astute "consumers" who judge quality through a variety of process indicators that reflect their experience in the management education program.

To help researchers better measure and interpret results obtained from of reactive evaluations, Brown (2005) proposed and tested a two-level measurement model, in which a second-order latent factor, an overall affective evaluation, underlies learners' judgment of specific dimensions of training. As a latent variable, an overall affective evaluation of instructional effectiveness cannot be directly measured, however, it can be manifest in underlying facets.

Action-directed learning. Cognitive theory stresses that high quality learning experiences provide students with immediate opportunities to act toward the solution of meaningful problems (Bransford *et al.*, 2000). SBL requires students to analyze a problematic situation, formulate a strategy that addresses important features of the problem context, and implement a solution in a dynamically changing situation. We refer to this problem-based, practice-oriented feature of the SBL learning environment as action-directed learning.

The problem scenario activates students' past experiences, thereby surfacing assumptions that can be questioned and discussed in light of new concepts, theories, and related information (Bransford, 1993; Prawat, 1989; Smith, 1996). This dynamic process of problem solving, which incorporates repeated practice on simulated tasks that offer timely feedback, is proposed to foster a deeper understanding of the "contingent" or "situated" use of knowledge (Leithwood and Hallinger, 1993; Bransford *et al.*, 2000; Korthagen and Lagerwerf, 1995; Rycus and Hughes, 2001; Salas *et al.*, 2009). Through practice on the simulation, students develop enhanced "pattern recognition," a feature that separates experts from novices in professional fields (Baldwin and Ford, 1988; Bransford, 1993; Wagner, 1993). Recent research on SBL conducted by Gary and Wood (2011) offers empirical support for these assertions. They found that "decision makers do not need accurate knowledge of the entire business environment; accurate

mental models of the key principles are sufficient to achieve superior performance” (Gary and Wood, 2011, p. 569):

H1. Students’ evaluation of action-directed learning in SBL classes will be higher than in classes using other instructional approaches.

Student engagement. Engagement indicates a positive absorbed state when an individual is involved in meaningful tasks (Seligman and Csikszentmihalyi, 2000). Research has linked higher levels of engagement with student achievement and social development (Klem and Connell, 2004; Hughes and Kwok, 2006; Smith *et al.*, 2005; Stallings, 1995). Designing instruction around authentic organizational scenarios and tasks increases student motivation and stimulates students to think and explore (Carroll, 2000; Shernoff *et al.*, 2003; Skinner and Belmont, 1993). The sense of challenge as well as fun engendered by the learning process may foster productive engagement.

Providing support and feedback is another pathway through which SBL promotes student engagement (Jang *et al.*, 2010; Klem and Connell, 2004). SBL instructors provide periodic supportive suggestions geared to the students’ level of understanding, while respecting the integrity of students’ activity (Hallinger and Bridges, 2007; Carroll, 2000). In some cases, this means subordinating the presentation of information or explicit instruction to the continuity of students’ practice on the simulation. Instructors supplement individualized feedback with periodic debriefings and lectures that provide a basis for collective sharing of “experience” – both real and simulated – as well as connections to theoretical models.

Finally, student engagement is also enhanced when there is a culture of cooperative learning in the classroom (Baldwin *et al.*, 1997; Cook, 2006; Kimber, 1996; Rosen *et al.*, 2008; Smith *et al.*, 2005; Tjosvold, 2008). During the simulation, team members find that they need to mutually support each other in order to solve the complex problem. This feature of cooperative learning increases student interdependence, individual motivation, and engagement (Kimber, 1996; Smith *et al.*, 2005; Tjosvold, 2008):

H2. Students’ self-evaluation of engagement in SBL classes will be higher than in classes using other instructional approaches.

Assessment and feedback. Authentic assessment tasks that are complemented by timely, specific feedback foster students’ learning (Nicol and Macfarlane-Dick, 2006). Students are especially receptive to suggestions about alternative strategies in the face of difficulties in achieving their goals during or immediately following after a simulation session. Computer simulations provide immediate feedback on the results of students’ strategic actions. This causes learners to reflect on the gap between their intended goals and actual consequences. Rapid corrective feedback should lead to higher levels of engagement, motivation, and enhance analytical reasoning (Alter *et al.*, 2007; Bransford *et al.*, 2000; Good and Brophy, 1987; Sansone, 1986).

Assessment in SBL courses can be targeted at both teams and individuals, and knowledge application as well as acquisition (Hallinger and Bridges, 2007; Rosen *et al.*, 2008). Assessment typically includes performance on the computer simulation, as well as an analytical paper. Together these provide insight into students’ ability to apply

knowledge as well as their understanding of the underlying theoretical knowledge base. Therefore, we propose that:

H3. Students' evaluation of assessment and feedback in SBL classes will be higher than in classes using other instructional approaches.

Instructor effectiveness. Instructor effectiveness, as opposed to instructional effectiveness, which we use as a broad encompassing term, is conceptualized as a feature of the particular teacher. This variable is a synthesis of the instructor's qualifications, disciplinary and practical knowledge, teaching skill, and communicative ability. More specifically, instructor effectiveness refers to the ability to apply the teacher's subject matter knowledge and instructional skills toward the achievement of learning goals for students (Shulman, 2000). We suggest that the teaching approach employed by instructors using SBL will positively impact student perceptions of their effectiveness:

H4. Student evaluations of instructor effectiveness will be higher in SBL courses than in courses using other instructional approaches.

Instructional effectiveness. For the purpose of this study, instructional effectiveness is conceptualized as an overall affective assessment of the quality of instruction as perceived by students. Students who attend graduate management programs tend to be goal-directed and career-oriented with a desire to complete the program successfully and learn useful content. Particularly in fee-paying programs, they tend to be astute "consumers" who judge quality through a variety of process indicators that come from their experience in the program. SBL seeks to create a highly engaging classroom environment in which student learning is action directed and subject to useful, timely feedback. These conditions should result in higher levels of overall perceived instructional effectiveness (Bransford *et al.*, 2000; Carroll, 2000; Smith *et al.*, 2005):

H5. Student evaluations of instructional effectiveness will be higher in SBL courses than in courses using other instructional approaches.

Method

This report examines a "naturally occurring experiment" in which an institution, the GSB, incorporated computer simulations into several courses that were taught term-by-term over a period of seven-years. The study employs a multiple time-series research design in order to investigate this phenomenon (Campbell and Stanley, 1966). In this research design, when studying change in the experimental group, "the researchers also seek out a similar institution [i.e. comparison group] not undergoing the X [i.e. exposure to the experimental effect], from which to collect a similar 'control' time series [...]" (Campbell and Stanley, 1966, p. 55).

The multiple time-series design makes it possible to employ powerful growth modeling techniques that are capable of exploiting the longitudinal feature of the data (Campbell and Stanley, 1966; Davies, 1994; Huber and van de Ven, 1995; Singer and Willett, 2003).

Nature of the treatment: the simulation-based courses

The GSB's Master of Management curriculum was delivered in English. Three courses were designed explicitly around computer simulations. These represent the "treatment"

examined in this study. Features of their instructional design and delivery focussing on the use of the simulations are briefly described here.

Leading organizational change (LOC). The LOC course was constructed around the Making Change Happen™ computer simulation and delivered as a seven-week, 1.5 credit course module. It presents learners with a common, high impact problem to solve: implementation of a new IT system in an organization. Although the simulation focusses on the implementation of a new IT system, lessons learned by students are broadly applicable to other types of organizational changes and innovations (e.g. reorganization, work process reengineering, merger, etc.).

Students play the simulation in teams consisting of between three and four members using time inside and outside of class. Each “project implementation team” is responsible for developing and applying a strategy for implementing the new IT system over a three-year period. The project team must develop and implement a change strategy that raises staff awareness of the new IT system, creates a broad base of staff interest, enables the staff to develop new skills, and generates commitment to using IT 2020 effectively in their daily work. The teams work toward two goals: widespread, effective use of the new IT system by staff members in the organization, and increased productivity. Students are able to “see progress” toward both goals as they implement the new IT system over a three-year period of simulated time.

Assessment is multi-faceted and includes both team and individual measures. First the teams write a team strategy paper that outlines their goals, strategy, decisions, and results. This detailed paper must describe, analyze, and evaluate their strategic implementation for one three-year implementation of the new IT system. Each individual must then write an individual case study of change based on their own organization. This generative case study must describe the change and also analyze it using theories of change learned in conjunction with the simulation. Third, the students will play the simulation all the way through one time in class and receive a grade based on their level of success in the simulation. Finally, there is a short case-based exam that is designed to assess basic knowledge and ability to apply theories and concepts from the course (see also Hallinger and Bridges, 2007).

Strategies for success (SFS). The SFS course is a seven-week 1.5 credit course module in strategic management. The course is designed around the use of the Threshold Entrepreneur computer simulation, (Anderson *et al.*, 2000). Threshold Entrepreneur is a web-based business simulation that allows students to compete against each other managing a small startup company. Students act as chief executives of a small company that sells two plastic molded products. A student team manages a company in competition with other student-managed companies. They are not in competition with the computer, but rather the computer’s function is just to process their decisions quickly and to provide reports that show the results of those decisions.

During the simulation, the instructor processes the decisions that teams make regarding the operation of their respective companies after all the competing teams have submitted their decisions. Students make decisions regarding marketing (e.g. pricing and promotion of the products), manufacturing (e.g. how many units to produce or whether to have the products manufactured by a sub-contractor), and financing (e.g. requesting a bank loan to pay current bills or accessing venture capital funding). The simulation offers students the opportunity to experience the decisions involved in formulating and implementing a business strategy in a competitive market. Students are expected to apply previously learned theoretical content on strategic management as well as to learn new content through the simulation. Assessment in the

course includes both performance on the simulation and a variety of written strategy reports, a presentation and a final exam.

Strategic marketing management (SMM). SMM, a three credit core course, employs a simulation, Pharmasim™ (Interpretive Solutions, n.d.), in which students manage brands of medicine (cold, cough, allergy) in a simulated market environment. The simulation consists of ten simulated time periods. Each period can take an hour for the instructor to play, and should therefore be even more demanding for a team of students. The simulation problem is dynamic and complex. Strategy formulation and decision making are interactive, and the complexity of the market situation and level of detail increase as play progresses.

Students are shown how to play the game in class and given a manual for learning support. Key marketing concepts taught in the strategic marketing course are integrated with the simulation both tacitly (i.e. embedded in Pharmasim decision rules) and formally (i.e. during course lectures and in readings). Students spend of the time playing the simulation outside of class. They typically play in teams consisting of five students.

Teams present progress reports twice during the term. The progress reports are an opportunity for students to receive instructor feedback and also for class discussion about strategies and outcomes. Students submit a strategy report that outlines their strategy and explains their strategic decisions in relation to their outcomes. The final report also provides an opportunity for students to discuss what they learned from the simulation. Formal course assessments include the group presentation and final report. Explanation of strategy, decisions and results receive greater emphasize in assessment than performance in the simulation.

Nature of the control: non-simulation-based courses

The main control group included all non-simulation-based courses (non-SBL courses) offered in the same graduate program during the same period. However, the non-SBL courses represented a very broad range and large number of courses. Therefore, we selected a smaller subset of non-SBL core courses as an additional comparison group[2].

The non-SBL core courses consisted of four courses: Economics, Finance, Principles of Management, Management Information Systems. We selected this subset of courses for two reasons:

- (1) These core courses were taken by all students at the beginning of the Master of Management program, and therefore the GSB's most experienced instructors were assigned to these classes. Thus, these courses would provide a strong benchmark against which to assess the SBL courses.
- (2) In order to foster a common quality standard across course sections, the GSB management required all instructors in core courses to use a common syllabus, course content, approach to instructional delivery and assessments. The same criterion applied to the three SBL courses, but not to all other courses in the GSB.

Selection of a subset of non-SBL courses made it possible to obtain and provide greater detail concerning the specific instructional methods employed in the comparison courses. We began by analyzing the syllabi and found that the core courses tended to be more "traditional" in their approach to curriculum design. Most used textbooks, and

in all instances course delivery was organized around disciplinary content rather than problems of practice (Hallinger and Bridges, 2007). We then consulted the course coordinators at the GSB in order to identify the range of instructional methods used in these courses. As displayed in Table I, the non-SBL core courses employed a wide range of instructional approaches including standard lecture and discussion, video-enriched lectures, cooperative group learning, problem-based learning, project-based learning, and business cases[3]. In sum, these data suggest that the core courses employed a diverse set of instructional methods aimed, to various degrees, at fostering active learning. While we do not present comparable data on all other courses in the GSB, we suggest that they would also have employed a similarly eclectic mix of instructional methods.

It is also worth noting that a general effort at quality improvement in teaching and learning was being implemented in the GSB concurrent with the beginning period of this research. This quality effort focussed on the implementation of new policies (e.g. faculty selection, faculty evaluation, reward, student assessment), working processes (e.g. common content in core courses, development of a video content library accessible by all instructors), and ongoing training for faculty in active teaching and learning methods. For example, over the seven-year period covered by this research, GSB faculty members obtained training in problem-based learning, cooperative learning, performance-based assessment, teaching for thinking, and case teaching. This quality improvement effort began in the spring of 2001 and continued in a sustained manner through the duration of the study.

Sample

The sample for this study consisted of students studying in the Master of Management program at the GSB. In total, 90 percent of the students were working full-time and studying part-time. The students worked at a variety of private and public sector organizations in Thailand. They were mostly Thai nationals, supplemented by a relatively small number of Chinese and Japanese students.

The unit of analysis for this study is the course. The research included data collected with the GSB's Course Evaluation Questionnaire for all courses taught between the first term (June) of the 2001 academic year and the second term of the 2007

Course/methods	Lecture and discussion	Video-enriched lecture	Cooperative team learning	Problem-based learning	Project-based learning	Business cases	Simulation
<i>Non-SBL core courses</i>							
Economics	x					x	
Finance	x					x	
Principles of management		x	x	x			
Management information systems		x			x	x	
<i>SBL courses</i>							
Leading organizational		x					x
Strategic for success	x					x	x
Strategic marketing management		x				x	x

Table I.
Instructional methods
used in SBL and
non-sbl core courses

academic year. Since the GSB operates in a trimester system, the measurement period included 20 trimesters in total.

Between 2001 and 2003, the three SBL courses were introduced into the program. As noted above, SMM was a required core course and LOC and SFS were electives. LOC was delivered a total of 69 times to 1,646 students by four different instructors during the study period. The SFS course was taught 47 times to 1,115 students by six different instructors during this period. The SMM course was taught a total of 86 times to 2,310 students by 12 different instructors. The profiles of instructors for SBL and all non-SBL courses were comparable in terms of the composition of nationality, age, terminal degree, teaching experiences, and industry experiences. We also note that 12 of the 22 instructors in the SBL courses also taught in the non-SBL core courses.

Differences among students in the treatment and control groups represent a potential source of bias in the results. Due to the anonymous nature of the data collected in end-of-term course evaluations, there is no way to link specific student characteristics to course attendance. Nonetheless, we offer several reasons which support the belief that students in the experimental and control groups were comparable:

- Students attended the master degree program in cohorts, thereby indicating that students included in the non-SBL and SBL courses were from a stable and similar same population (i.e. students attending the GSB during the same period of time).
- As noted, all students attended the non-SBL core courses. SMM, which was in fact a core course that employed SBL, was taken by all students in every cohort. Analysis of course data (not tabled) further indicated that the average percentage of students taking LOC and SFS across the seven cohort groups was 66 and 50 percent, respectively.

Table II includes the sample characteristics broken down into three groups of courses for the period between 2001 and 2007. The response rate for all three categories of courses exceeds than 80 percent. Thus, the study reports student perceptions concerning key indicators of instructional effectiveness with respect to these three sets of courses.

Instrument

The GSB's Course Evaluation Questionnaire was administered to students at the conclusion of each term. Course evaluation questionnaires are subject to a variety of potential problems when employed as tools for academic research (Aleamoni, 1999;

Students, instructors and classes	SBL classes	Non-SBL classes (core)	Non-SBL classes (all)	Total
Number of course sections	202	354	1,182	1,384
Number of instructors	22	54	175	185
Average students per section	25.10	26.74	24.67	24.74
Total number of students	5,071	9,465	29,163	34,234
Total returned questionnaires	4,433	7,705	23,667	28,100
Response rate	87%	81%	81%	82%

Table II. Summary course, instructor, student information (2001-2007)

Notes: SBL classes, simulation-based classes; non-SBL classes, non-simulation-based classes. 12 instructors taught both SBL and all non-SBL classes

Scriven, 1988). Points of criticism include mixed purpose questions, item wording that biases student responses, overly long forms, ambiguous and compound questions, comparative questions, inconsistent or biased procedures for administration and processing of forms, and methods of analysis that provide a distorted picture of results (Lyon and Hendry, 2002; Scriven, 1988). Nonetheless, a substantial body of research clearly supports the potential of purposively designed course evaluation questionnaires for providing reliable and valid data (Aleamoni, 1999).

The questionnaire consisted of a total of 17 items and used a five-point Likert scale in which a higher score represents a greater extent or higher effectiveness. Both the questionnaire design and procedures for administering and using the college's evaluation form sought to address features that typically threaten the validity of such scales (Marsh and Roche, 1997; Scriven, 1988). The multidimensional scale was designed after a thorough review of scales used internationally by other universities and in consultation with psychometricians. The questionnaire was administered systematically by the college's academic support staff who received several rounds of training for the task. During administration of the questionnaire, the instructor was required to physically leave the room and completed forms were collected by members of the academic staff, not by the instructor. Completed forms were sent to an external company for data entry prior to analysis by college staff. These procedures were designed with the goal of increasing the validity of student ratings (Aleamoni, 1999; Scriven, 1988).

Operational variables

In order to test the first four hypotheses proposed, ten items were selected and categorized into four dimensions: instructor effectiveness, action-directed learning, student engagement, and assessment and feedback. We provide operational definitions for each of these variables below.

Instructor effectiveness was defined as the professional knowledge and capacity to communicate, organize and present information effectively to students individually and collectively. This dimension was assessed through four items that asked students to rate instructors' knowledge in the subject, preparation for class, clarity of responses to students' questions, and overall rating of the instructor. The α coefficient for this scale was 0.95.

Action-directed learning was defined as the extent to which a course was able to bridge theoretical knowledge and practical application in the business context. This was measured by two items that asked students how well the course helped them understand the subject and make theoretical content practical. It was worth noting that the item of helping students understand the subject was added into the questionnaire in 2005, so the data were adopting only one item from 2001 to 2004. The α coefficient for this scale was 0.95.

Student engagement represents the intensity and emotional quality of students' involvement in participating in the module's learning activities (Edgerton, 2001; Skinner and Belmont, 1993; Smith *et al.*, 2005). This was measured by two items that asked students to rate the extent to which the course allowed them to become actively involved in their learning and encouraged students to learn from each other. The α coefficient for this scale was also 0.95.

Assessment and feedback was defined as the quality of assessment of students' learning and provision of useful feedback that contributes to learning. This was assessed through two items that asked students to rate the class on the appropriateness

of assignments and quality of instructor feedback. The α coefficient for this scale was 0.90.

Instructional effectiveness was defined as an overall evaluation (second-order latent construct) that determines specific assessment dimensions (first order reaction factors). Our end-of-course assessment data confirmed to the characteristics of a multidimensional reactive evaluation. We therefore expected that there would be an underlying latent construct (overall perceived instructional effectiveness) predicting the afore-mentioned four assessment dimensions. The fifth hypothesis was tested using this overall perceived assessment of instructional effectiveness.

Data analysis

Data analysis focussed on three main issues. First, because the scale employed in this study was developed by the GSB staff, we tested its measurement properties. This entailed testing to determine whether items loaded on designated dimensions of measurement and further loaded on a second-order single factor (Brown, 2005).

Next, then we sought to understand whether students reported that the SBL courses consistently met the criterion at a high standard. By high standard, we refer to the absolute level of student evaluations. This was accomplished by examining absolute levels of ratings beginning with descriptive statistics. Over time, with use of the Course Evaluation Scale, a high standard came to be defined in practical terms as 4.0 on the five-point Likert scale. Independent samples *t*-tests were then conducted to test the difference between the baseline term and last three terms. Subsequent mixed-effects model analyses sought to exploit the longitudinal features of the data regardless of instructional approaches. The test provided an ideal statistical tool for the purposes of modeling change trend in this particular context (Davies, 1994; Huber and van de Ven, 1995; Singer and Willett, 2003).

Last, we tested the five hypotheses designed to determine whether students perceived SBL courses as more effective than courses on various dimensions. This was conducted initially with independent samples *t*-tests. Subsequent mixed-effects modeling sought to exploit the longitudinal features of the data set by incorporating instructional approaches to the tested trend model. This time the test focussed on estimating the associations between instructional approaches and students' perceptions of instructional effectiveness while accounting for the change trend and correlations between repeated observations on the same individual instructors over time. Thus, in a sense, this test controls for individual instructor differences and the broader changes that were occurring in the institutional context over time.

Results

Measurement validation

Principal axis factor analysis with a Promax rotation of the ten items yielded a single factor explaining 81.65 percent of the variance. We conducted a series of confirmatory factor analyses in testing the hypothetical measurement model. The results were shown in Table III. M6 is the hypothetical model which freely estimates the four paths from overall instructional effectiveness to action-directed learning, student engagement, assessment and feedback, and instructor effectiveness. M1 is a second-order model that constrains the four paths from an instructional effectiveness to action-directed learning, student engagement, assessment and feedback, and instructor effectiveness. M2 is the same as M1 except that instructional effectiveness to action-directed learning is freely estimated. M3 is the same as M1 except that

Models	χ^2	df	$\Delta\chi^2$ (vs M6)	RMSEA	NFI	NNFI	CFI
1-factor model (M0)	1,152.56	35	–	0.15	0.94	0.92	0.94
4 factor model with 2nd order factor (M1)	1,696.85	34	1,193.79(3)***	0.19	0.91	0.88	0.91
4 factor model with 2nd order factor (M2)	662.85	33	159.66(2)***	0.12	0.96	0.95	0.97
4 factor model with 2nd order factor (M3)	1,399.67	33	896.49(2)***	0.17	0.96	0.90	0.93
4 factor model with 2nd order factor (M4)	1,660.60	33	1,157.42(2)***	0.19	0.91	0.88	0.91
4 factor model with 2nd order factor (M5)	1,680.72	33	1,177.53(2)***	0.19	0.91	0.88	0.91
4 factor model with 2nd order factor (M6)	503.19	31	–	0.10	0.97	0.96	0.98

Notes: NFI, normed fit index; NNFI, nonnormed fit index; CFI, comparative fit index. M0, simple one-factor models (without a second-order latent construct); M1, second-order model that constrains the four paths from overall perceived instructional effectiveness to action-directed learning, student engagement, assessment and feedback, and instructor effectiveness. M2 is the same as M1 except that instructional effectiveness to action-directly learning is freely estimated. M3 is the same as M1 except that instructional effectiveness to student engagement is freely estimated. M4 is the same as M1 except that instructional effectiveness to assessment & feedback is freely estimated. M5 is the same as M1 except that instructional effectiveness to instructor effectiveness is freely estimated. M6 is the hypothetical model which freely estimates the four paths from instructional effectiveness to action-directed learning, student engagement, assessment and feedback, and instructor effectiveness. *** $p < 0.001$

Table III. Summary of measurement model comparison

instructional effectiveness to student engagement is freely estimated. M4 is the same as M1 except that instructional effectiveness to assessment and feedback is freely estimated. M5 is the same as M1 except that instructional effectiveness to instructor effectiveness is freely estimated.

Comparison of the models revealed that M6 provided significantly better fit to the data than the other five nested models. The results further indicated that the four dimensions included in this study are distinguishable, and there is an underlying latent factor. Therefore, the remaining analyses use the four dimensions as well as the composite indicator for overall perceived instructional effectiveness.

Descriptive analysis

In the baseline term, the mean instructional effectiveness for all courses in the GSB was 3.71 on the five-point Likert scale. Figure 2 shows the pattern of growth in instructional effectiveness for SBL, non-SBL core courses, and all non-SBL courses term-by-term over the seven-year period (see detailed annual statistics in Table IV). All three categories of courses evidenced fluctuation during early years of the study.

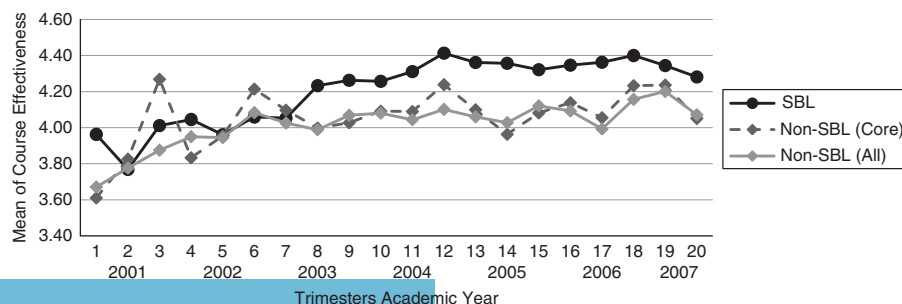


Figure 2. Trend of means of instructional effectiveness ratings (2001-2007)

Table IV.
Measures information,
means, standard
deviations, and *t*-test
results

Dimensions	N of items	α	2001a M (SD)	2002 M (SD)	2003 M (SD)	2004 M (SD)	2005 M (SD)	2006 M (SD)	2007a M (SD)	2007b M (SD)	Total M (SD)	<i>t</i> (vs. SBL)	Sig.
<i>1. Instructional effectiveness</i>													
SBL classes	10	0.98	3.88(0.41)	4.01(0.28)	4.16(0.27)	4.31(0.23)	4.35(0.21)	4.37(0.20)	4.31(0.23)	4.17(0.33)	4.17(0.33)	–	–
Non-SBL classes (core)			3.72(0.29)	3.94(0.35)	4.04(0.34)	4.13(0.33)	4.04(0.37)	4.12(0.35)	4.13(0.37)	4.01(0.37)	4.01(0.37)	4.98	***
Non-SBL classes (all)			3.76(0.38)	3.99(0.31)	4.02(0.37)	4.07(0.41)	4.07(0.38)	4.08(0.37)	4.13(0.38)	4.00(0.39)	4.00(0.39)	6.65	***
<i>2. Instructor effectiveness</i>													
SBL classes	4	0.95	3.98(0.43)	4.09(0.30)	4.21(0.29)	4.40(0.24)	4.42(0.22)	4.45(0.22)	4.42(0.21)	4.25(0.34)	4.25(0.34)	–	–
Non-SBL classes (core)			3.90(0.31)	4.10(0.35)	4.20(0.35)	4.26(0.36)	4.20(0.38)	4.27(0.33)	4.28(0.39)	4.17(0.37)	4.17(0.37)	2.58	*
Non-SBL classes (all)			3.90(0.40)	4.13(0.32)	4.15(0.37)	4.19(0.41)	4.19(0.38)	4.21(0.36)	4.25(0.39)	4.13(0.39)	4.13(0.39)	4.72	***
<i>3. Action-directed learning</i>													
SBL classes	2	0.95	3.82(0.47)	3.94(0.34)	4.11(0.31)	4.27(0.26)	4.33(0.22)	4.33(0.23)	4.25(0.26)	4.12(0.37)	4.12(0.37)	–	–
Non-SBL classes (core)			3.67(0.36)	3.88(0.38)	3.97(0.39)	4.11(0.36)	3.95(0.43)	4.04(0.39)	4.04(0.43)	3.95(0.41)	3.95(0.41)	4.84	***
Non-SBL classes (all)			3.71(0.40)	3.96(0.36)	3.98(0.41)	4.06(0.44)	4.03(0.44)	3.99(0.43)	4.05(0.47)	3.95(0.44)	3.95(0.44)	5.86	***
<i>4. Student engagement</i>													
SBL classes	2	0.95	3.82(0.43)	3.97(0.31)	4.15(0.28)	4.27(0.26)	4.37(0.28)	4.35(0.25)	4.24(0.29)	4.14(0.37)	4.14(0.37)	–	–
Non-SBL classes (core)			3.57(0.35)	3.84(0.38)	3.93(0.38)	4.03(0.36)	3.91(0.37)	4.05(0.37)	4.04(0.37)	3.91(0.40)	3.91(0.40)	6.81	***
Non-SBL classes (all)			3.65(0.40)	3.90(0.34)	3.95(0.41)	4.00(0.45)	3.99(0.41)	4.03(0.39)	4.07(0.40)	3.92(0.42)	3.92(0.42)	7.01	***
<i>5. Assessment and feedback</i>													
SBL classes	2	0.90	3.76(0.36)	3.91(0.24)	4.10(0.28)	4.20(0.22)	4.21(0.21)	4.26(0.22)	4.22(0.28)	4.07(0.32)	4.07(0.32)	–	–
Non-SBL classes (core)			3.51(0.28)	3.77(0.40)	3.87(0.34)	3.96(0.32)	3.91(0.38)	3.98(0.38)	4.02(0.33)	3.86(0.38)	3.86(0.38)	6.93	***
Non-SBL classes (all)			3.62(0.38)	3.83(0.35)	3.87(0.38)	3.93(0.42)	3.93(0.38)	3.94(0.38)	4.02(0.36)	3.86(0.40)	3.86(0.40)	8.36	***

Notes: M, mean; SD, standard deviation. ^aThe statistics in the columns 2001 to 2006 integrated the data of three trimesters each year; ^bthe statistics in the column of 2007 integrated data of two trimesters in 2007. * $p < 0.05$; *** $p < 0.001$

Even with these fluctuations, there was a common pattern of growth for all three sets of courses before stabilizing around the sixth term at a higher level. This pattern of results probably reflects the effect of the more effort to improve teaching and learning quality in the GSB concurrent with the beginning period of this research.

Following these descriptive analyses suggesting growth over time, we wished to understand if the observed changes were statistically significant. We assessed improvement in instructional effectiveness for all GSB courses between the baseline term and the last three terms studied. An independent samples *t*-test indicated that the change was both substantial for a five-point scale (i.e. +0.45) and statistically significant ($t = 9.53$, $p < 0.001$). While these results suggest evidence of a significant change in overall perceptions of instructional effectiveness in the GSB, we note that the *t*-test alone offers a relatively weak assessment of change when using a longitudinal research design (Campbell and Stanley, 1966). We therefore, supplemented this test with additional analyses.

We also wish to call attention to the pattern of variance in the ratings of instructional effectiveness (see Table IV and Figure 3). Analysis of variation in course ratings offers an essential complement to the analysis of mean ratings of instructional effectiveness (Scriven, 1988) in that it also offers a perspective on the consistency in quality of delivery across instructors and course sections. With respect to variation in instructional effectiveness, we first observe that SBL courses demonstrated significantly lower variance (average SD = 0.33 in SBL vs 0.39 in all non-SBL courses) when compared across 20 measurement occasions (mean difference = 0.12, $t = 5.37$, $p < 0.01$). Moreover, the magnitude of variance among SBL courses tended to decrease and then stabilize at a significantly lower level over time. Taken together, these data suggest a higher level of improvement, more consistent growth, and greater stability (i.e. lower variability) in the delivery of the SBL courses over a substantial period of time.

It is also of interest to drill down into the pattern of variation in instructional effectiveness ratings for the three SBL courses. The growth pattern in mean instructional effectiveness ratings is displayed in Figure 4. We note that the trend in instructional effectiveness for the three SBL courses tended to show greater variation and fluctuation in the early stages of simulation implementation for the two shorter courses in which the simulations played a more substantial role[4]. This could have reflected the lack of instructor experience in using these methods, as well as turnover in instructor teams.

Hypothesis testing

To further explore the statistical significance of these growth trends for the two different sets of courses, we established mixed-effects models by fitting higher order

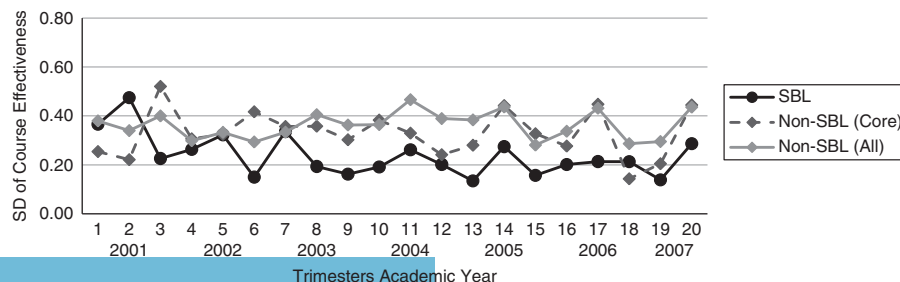


Figure 3.
Trend of standard
deviations of instructional
effectiveness ratings
(2001-2007)

polynomials in the same fashion to each assessment dimension over time. Three terms were included in the models, presenting linear, quadratic (U-shaped), and cubic (S-shaped) relationships between time and course evaluations, respectively (Heck *et al.*, 2010). Time, or the linear term of time, was coded from academic trimesters ranging from 1 to 20. Individual instructors were the repeated subjects in each mixed model. The repeated measure was the linear term of time. Because instructors taught varying number of course sections within each trimester, we averaged course sections taught by the same instructor within each trimester.

The results of the estimates of intercepts and three shape (i.e. growth) terms for each assessment dimension are presented in Table V. The significant results with the linear term reinforce the finding of a consistent rate of growth in evaluations of instructional effectiveness over the seven years. Significant results with the quadratic and cubic terms would suggest that the rate of growth or decline changed over time. However, a closer examination of estimates reveals that the magnitude of estimates with the quadratic and cubic terms was trivial (≥ 0.01). Therefore, these significant findings could have resulted from the large sample size.

As we observed in Figure 1, there was a fairly constant rate of growth in instructional effectiveness, except for declines in the fifth and sixth terms in 2002. This growth trend is important because it suggests that in subsequent analyses the SBL courses are being assessed in the context of continuous overall improvement of teaching and learning at the college. The modeling also provides useful illustration of the fact that it can take several years for an instructor or instructional team to gain the confidence and competencies for using new instructional methods.

We also wish to reemphasize that all “non-SBL courses” in the GSB were concurrently undertaking intentional measures designed to create a more active

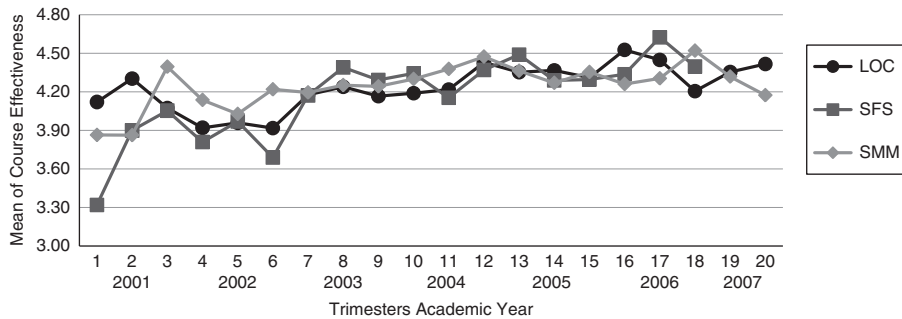


Figure 4. Mean ratings for three simulation-based courses on instructional effectiveness (2001-2007)

	Instructional effectiveness			Instructor effectiveness			Action-directed learning			Student engagement			Assessment and feedback		
	F	E	Sig.	F	E	Sig.	F	E	Sig.	F	E	Sig.	F	E	Sig.
Intercept	3,135.85	3.57	***	3,355.20	3.75	***	2,404.61	0.12	***	2,586.11	3.44	***	2,896.12	3.42	***
Time (linear)	14.25	0.10	***	9.07	0.08	**	14.14	0.02	***	16.06	0.12	***	19.68	0.12	***
Time (quadratic)	7.25	0.00	**	4.35	-0.00	*	6.95	-0.01	**	7.68	-0.01	**	10.85	-0.01	**
Time (cubic)	4.98	0.00	*	2.94	0.00	ns	4.36	0.00	*	5.10	0.00	*	8.18	0.00	**

Table V. Results of testing the shape of trend

Notes: E, estimates of fixed effects; ns, not significant. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

learning environment. Based on the data presented, it appears that the college was succeeding in this respect. More relevant for our analysis, however, is that the SBL courses were being measured against a set of courses that had also demonstrated strong improvement and stabilized at higher level on the rating scale.

Next we used independent samples *t*-tests on the seven years of data to compare SBL courses with all non-SBL courses on specific dimensions of instructional effectiveness. As reported in Table IV, these tests indicated that students reported significantly higher scores for SBL courses on instructional effectiveness (mean difference = 0.17, $t = 6.65$, $p < 0.001$), instructor effectiveness (mean difference = 0.12, $t = 4.72$, $p < 0.001$), action-directed learning (mean difference = 0.17, $t = 5.86$, $p < 0.001$), student engagement (mean difference = 0.22, $t = 7.01$, $p < 0.001$), and assessment and feedback (mean difference = 0.21, $t = 8.36$, $p < 0.001$). These results supported all five of the proposed hypotheses. The pattern of results was consistent when SBL courses were compared with non-SBL core courses.

We then used mixed-effects models to conduct a more robust test of differences between the SBL and non-SBL courses. The earlier trend analyses had revealed that the dominant shape of the change trend was linear. Therefore, we included three fixed-effect factors in the model: class size, the linear term of time, and instructional approach. Individual instructors were the repeated subjects. Since mixed-effects models allow only one observation at each time point within a repeated subject, 12 instructors who taught both SBL and non-SBL courses were coded as separate instructors. The repeated measure was again the linear term of time. Therefore, in each model, we included factors that were of interest a priori, but with a particular focus on the association between instructional approach and the specific dimensions of instructional effectiveness.

The results of the mixed-effects modeling (see Table VI) were generally consistent with the *t*-tests results (see Table IV). When testing SBL courses against all non-SBL courses, there was a positive main effect of time on student evaluations of courses on Instructional Effectiveness and all four composite dimensions. Learning in SBL courses monotonically increased student perceptions on instructor effectiveness (estimate of fixed effect = 0.15, $p < 0.051$), action-directed learning (estimate of fixed effect = 0.21, $p < 0.01$), student engagement (estimate of fixed effect = 0.24, $p < 0.001$), assessment and feedback (estimate of fixed effect = 0.23, $p < 0.001$), and instructional effectiveness (estimate of fixed effect = 0.20, $p < 0.01$). This pattern of results remained stable when SBL courses were compared with the subset of non-SBL core courses, except that the result was not significant with instructor effectiveness (estimate of fixed effect = 0.07, $p = ns$).

While these quantitative results support the proposition that SBL courses created an action-directed, engaging and productive learning environment, they do not provide insight in the character of students' experience in these classes. Therefore, we also include supplementary comments drawn from open-ended questions on the Course Evaluation Questionnaires. Students' comments drawn were sorted and selected to provide anecdotal insight into how students experience SBL classes:

[...] made the course content practical. What I learned today I could apply in my job over the next days (LOC student).

[...] was challenging and forced me to think about what I believed about getting results before the course (LOC student).

[...] working with my classmates on the simulation was a challenge and also fun. Trying to get to the Master level was really hard but we felt great when we made it (LOC student).

Table VI.
Estimates of fixed effects for instructional effectiveness and assessment dimensions

	Instructional effectiveness			Instructor effectiveness			Action-directed learning			Student engagement			Assessment and feedback		
	F	E	Sig.	F	E	Sig.	F	E	Sig.	F	E	Sig.	F	E	Sig.
<i>SBL vs non-SBL (core)</i>															
Intercept	2,525.62	4.18	***	2,520.41	4.23	***	1,827.34	4.19	***	2,054.33	4.10	***	2,244.89	4.11	***
Class size	25.56	-0.01	***	18.62	-0.01	***	23.88	-0.02	***	20.51	-0.01	***	25.91	-0.01	***
Time (Linear)	19.87	0.02	***	14.34	0.02	***	15.25	0.02	***	26.16	0.02	***	31.05	0.02	***
Instructional approach (0 = non-SBL; 1 = SBL)	4.32	0.14	*	1.04	0.07	n.s.	5.19	0.16	*	9.20	0.20	**	10.33	0.19	**
<i>SBL vs non-SBL (all)</i>															
Intercept	4,665.16	4.16	***	4,744.11	4.25	***	3,684.25	4.15	***	3,974.53	4.08	***	4,515.99	4.07	***
Class size	33.74	-0.01	***	29.91	-0.01	***	33.56	-0.01	***	26.13	-0.01	***	32.67	-0.01	***
Time (linear)	22.92	0.02	***	17.05	0.01	***	16.60	0.01	***	32.05	0.02	***	38.72	0.02	***
Instructional approach (0 = non-SBL; 1 = SBL)	9.95	0.20	**	5.68	0.15	*	9.35	0.21	**	13.98	0.24	***	16.97	0.23	***

Notes: E, estimates of fixed effects. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Once we began, we couldn't stop playing the simulation. I must have played the simulation 50 times at home but never got bored. Very challenging (LOS student)
This was the first class where we were competing against other groups for our result. Even though that created anxiety, we just worked harder to succeed (SFS student).
The module made us rethink and apply what we had learned in Finance, Strategic Management, and Marketing courses in a more practical way (SFS student).
The (*Pharmasim*) simulation made the rest of the marketing course content more practical. I had to think about the theories together instead of separately. It also got me to know my classmates better (SMM student).
Since we played the simulation for many weeks it put the parts of the course into a whole for me (SMM student).

Discussion

This study employed a quasi-experimental, multiple time-series design to evaluate the instructional effectiveness of SBL in a Master of Management program in Thailand. Drawing upon student course evaluation data gathered over a seven-year period, the research compared results from three courses that used computer simulations with the results of other courses over a period of 20 trimesters. The study's hypotheses were supported by the empirical findings:

- (1) Students rated instructors as more effective in SBL courses than in comparison courses.
- (2) Students consistently perceived SBL as more action-directed and engaging than comparison courses.
- (3) SBL courses provided more useful and timely feedback and assessment information to students than did comparison courses.
- (4) There might be no significant differences in perceived instructor effectiveness between SBL courses and other courses. This finding should be interpreted in light of improvements in levels of instructor effectiveness ratings consistently demonstrated in both sets of courses over time. Thus, the finding of "no differences" implies that effects on the other dimensions of instructional effectiveness noted above were probably not due to differences in instructor capability.
- (5) SBL courses yielded a pattern of significantly higher evaluations with less variability on instructional effectiveness over time than comparison courses.

In sum, the findings indicate that students in this institutional setting perceived that SBL offered specific advantages in terms of creating active, engaging and productive environments for learning management subjects. The combination of challenge and enjoyment in the learning process appeared to lead to higher levels of engagement with course content both inside and outside of class. The consistency of experimental results obtained over a seven-year period with a large number of instructors and students provides empirical support for assertions in the literature concerning the potential of SBL in management education (Salas *et al.*, 2009). Nonetheless, before considering the implications of these findings, we wish to revisit the study's limitations.

Limitations

This study is subject to several limitations that should be considered when interpreting these results. First, while the findings suggest that students perceived SBL as an effective approach to learning, the study was limited to single institutional setting.

Features of the students (e.g. the predominance of Thai nationals), the instructors (e.g. a substantial percentage of part-time, industry affiliated instructors), a small number of simulations, and the organizational setting (e.g. active engagement in a quality drive to improve teaching and learning in the GSB) combine to contextualize and possibly limit the generalizability of the results. This suggests that the findings require further replication in other settings and with other simulations.

Second, the study relied solely upon course evaluation data collected from students. While the instrument offers reliable data, other potentially relevant dimensions may be missing from current scale. Moreover, student evaluations can be influenced by situational and dispositional factors such as grades (Cohen, 1981; Clayson *et al.*, 2006), and interest in a subject area (Brown, 2005; Friedrich, 1998). With respect to the former, we do note that student grades were not released until after the evaluations were completed by students. The latter factor should not have distorted the results of our analyses since both the SBL courses and other non-SBL courses included a mix of required and optional subjects.

Perhaps more important in terms of limitations, a single-source evaluation of instructional effectiveness is insufficient for the purposes of yielding a comprehensive endorsement of SBL in management education. Multiple source assessments of instructional effectiveness (e.g. observations by supervisors or assessment of learning outcomes) would provide a more solid basis for interpreting the meaning of the students' ratings. More specifically, data on learning gains as well as retention and transfer beyond the classroom are warranted in future studies. Even as we acknowledge this limitation, however, we also wish to reemphasize our belief that student ratings of instructional effectiveness do offer one valid and important perspective on the efficacy of an instructional approach (Aleamoni, 1999; Good and Brophy, 1987; Lyon and Hendry, 2002; Marsh, 1981; Marsh and Roche, 1997; Korthagen and Lagerwerf, 1995; Scriven, 1988). This is especially true in the market-driven world of graduate management education.

Third, the teaching methods adopted in the comparison classes were less specifically delimited than in the SBL courses. The research design did not, for example, directly compare the instructional effectiveness of SBL with one alternative teaching method such as case teaching. In fact, as noted in Table I, even in the core courses GSB instructors employed an eclectic mix of instructional approaches. While this is not an uncommon characteristic of field experiments (Campbell and Stanley, 1966), it does limit our ability to define the nature of the "comparative advantage" demonstrated by SBL on the criterion variables over other modes of instruction.

Finally, we have noted that the initiation of these simulation-based courses was concurrent with a wide-ranging quality improvement program undertaken by the GSB. This suggests that at least a portion of the effectiveness demonstrated by the SBL courses could have been due to other unmeasured variables related to the quality improvement effort. Nonetheless, we suggest that this limitation should not have impacted the results of the comparison tests conducted in the study, as the courses in control groups were also the target of improvement. Indeed, growth trend analysis (Table V) indicated an overall improvement in instructional effectiveness over time regardless of instructional approach, though the differences in mean levels, stability of results, and degree of variance favored the SBL courses.

Implications

The results of any single quasi-experimental study cannot provide a conclusive answer to the hypotheses proposed in this study, regardless of the strength and significance of

the result. Nonetheless, we wish to suggest that the results provide an incremental advance in the empirical validation of SBL as one useful instructional approach in the repertoire of management education and training programs.

The results also offer an interesting perspective on the implementation new teaching pedagogies in management programs. The longitudinal nature of the data set made it possible to see the process of change implementation with a clarity that would have been impossible with cross-sectional data (e.g. see Figures 2 and 3). The data revealed that the GSB's adoption of SBL went through an implementation process that took several years before stabilizing at a higher level of effectiveness. The change process involved ongoing design, evaluation, and refinement of the SBL modules, including the instructional methods used with them, the associated readings, and the means of assessment and feedback. It took time for the initial instructors, as well as new ones who joined the teaching teams over the years, to gain mastery over a new method of teaching, learn to use performance-based assessments, and manage multiple course sections at a high quality standard. This required a collective effort among managers and faculty over a long period of time.

We note that the GSB's Master of Management program consisted predominantly of early and mid-career working professionals as well as a small percentage of fresh graduates from Bachelor degree programs. Although we did not test for differences related to working experience, anecdotal evidence suggested that both groups found simulation-based courses equally engaging, though perhaps for slightly different reasons. We suggest that simulations offer a needed experiential base on which early career professionals simulations can engage and apply new knowledge. In contrast, seasoned managers find simulations especially useful for checking their assumptions about "the way things work" and refining their existing management strategies. While this report did not compare the two groups, future research that explores responses to the use of simulations by the two groups quantitatively and qualitatively would be of value.

Finally, these findings have implications for the debate over the response of Asian students to methods of active learning (Watkins, 2000). For example, Kember (2000) claimed that:

[C]ommon misperceptions of the learning approaches and preferences of Asian students have resulted in the adoption of didactic teaching methods and assessment and examinations which test recall. If the academics concerned realize that Asian students are capable of more active forms of learning and benefit from curricula which demand higher forms of learning, the performance could be better still (p. 117).

Our research supports the position that Asian students can respond positively to active forms of learning, such as SBL. We note anecdotally that the LOC and SFS courses were offered as elective subjects and maintained strong enrollments despite workload expectations that were substantially higher than those of many other courses. Thus, in this setting, the use of simulations was viewed by both instructors and students as a high quality tool for achieving the GSB's goal of learner-centered, practice-oriented, theoretically informed management education.

Notes

1. Well-designed simulations incorporate varying degrees of randomness or unpredictability into their decision rules. This cues students to the fact that managers never have complete control over events, even when their "strategy" is "correct." It also highlights the need to consider a wide range of consequences and contingencies for decisions as well as how research-based knowledge must be adapted when put into practice.

2. The M.M. curriculum included five core courses, one of which was strategic marketing management. However, since this course employed a simulation, it was included among the SBL courses.
3. We refer to project-based learning as a team project focussed on the application of previously taught theories and disciplinary knowledge. Problem-based learning refers to cooperative team learning in which a problem is the initial stimulus for learning new content (Barrows, 1993; Hallinger and Bridges, 2007). Cooperative team learning (Kimber, 1996; Smith *et al.*, 2005) refers to a specific form of structured group learning which may or may not be problem-focussed. Reference to the use of business cases follows the traditional style of large class teaching and discussion focussed on a formal business problem (e.g. Garvin, 1991).
4. As noted LOC and SFS were offered in the consulting practice track of the curriculum. Thus, these were 1.5 as opposed to three credit courses, and lasted seven weeks as opposed to 13 weeks in duration. Thus, the simulations represented the primary mechanism of learning in these courses.

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Further reading

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