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Business simulation and assurance of learning

Gender, academic major and business core course performance

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Abstract

Purpose – This study aims to consider assurance of learning among undergraduate business students enrolled in capstone business strategy courses using the GLO-BUS competitive simulation. Gender, academic major and business core course performance were examined.

Design/methodology/approach – Participants were 595 undergraduate capstone business students from 21 course sections taught over a four-year period. Variables included learning assurance measures, simulation performance, gender, major, business core course grades, capstone course grade and cumulative grade point average. Correlations, linear regression, multiple regression and multivariate analysis of variance (MANOVA) were used to analyze the data.

Findings – Learning assurance report scores were strongly related to simulation performance. Simulation performance was related to capstone course grade, which, in turn, was significantly related to the grade point average (GPA). Core business courses were related to learning assurance and performance indicators. Significant differences for gender and degree major were found for academic performance measures. Women and men did not differ in simulation performance.

Research limitations/implications – Limitations include the use of one simulation (GLO-BUS) and studying students at one university taught by one professor. Assurance of learning measures needs further study as factors in business program evaluation. Future research should analyze post-graduate performance and career achievements in relation to assurance of learning outcomes.

Originality/value – This study conducts empirical analyses of simulation learning that focuses entirely on direct measures, including student characteristics (gender, major), learning assurance measures, business core course grades, capstone course grades and student GPAs.

Keywords Decision-making, Strategic management, Business education, Quality assurance, Assessment, Learning methods

Paper type Research paper

Business programs should carefully plan their strategic management capstone courses in light of the educational mission, pedagogical content knowledge, instructional techniques and delivery formats (Alstete and Beutell, 2016). Specifically, faculty members and academic departments should select project assignments, such as business simulations, that create an integrative learning experience for students as part of a planned portfolio of programmatic content and expected outcomes. As the use of technology-based instructional tools increases, it is important to harmonize instructional methods and learning outcomes to optimize the benefits of capstone business strategy courses.

This study examines learning assurance scores derived from participation in a capstone business simulation (GLO-BUS) in relation to gender, academic major, business core course grades, capstone course grades and overall grade point average (GPA). The extent to which learning assurance measures from capstone simulations are related to business core courses is

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an important empirical question. There is "face validity" to support such a connection between core courses and learning assurance, yet simulations utilize different skills and learning modalities than most core courses. Is the capstone course truly integrative of the core program courses or does it do something else? Further, gender and academic major are also studied. The notion that women are "poets" and men are "quants" (Wallen *et al.*, 2017) suggests that women might be at a competitive disadvantage in a quantitative, simulation environment. Is this valid? Finally, the influence of academic major is explored as well. Does academic business major (e.g. accounting, management) relate to simulation performance and learning assurance?

There is a difference between studies that investigate learning perceptions compared to those that present direct evidence of student learning outcomes (Anderson and Lawton, 2009). This study focuses on the latter (i.e. direct evidence). This is not to diminish the value of student perceptions of learning but to emphasize the importance of assessing actual learning results. Desired learning outcomes typically fall into three categories: cognitive, attitudinal and behavioral (Faria, 2001; Gentry and Burns, 1981; Hsu, 1989; Knotts and Keys, 1997; Wolfe, 1997). Simulations include all three learning categories. However, literature suggests that the fundamental concepts of business strategy can be delivered more quickly in lectures. Nevertheless, this raises questions about retention of lecture material. Will students be able to remember and/or execute the concepts derived from lectures? Anderson and Lawton (2009) state that the research confirms that simulations are less effective than other teaching methods in enabling students to understand specific concepts yet are more effective at conveying higher levels of learning than the lecture method. Simulations help to bridge the learning–doing gap.

Along with other types of active learning, simulations help students to gauge their performance in relation to their peers. Simulations also provide metrics that can quantify student performance and provide objective feedback (Bowen, 2017). As such, simulation metrics can be compared with other students within the course, institution, nation or globally (Angolia, 2019). Analysis of student performance measures creates an opportunity for faculty members to foster a world-class learning environment that distinguishes their courses and programs from peer and aspirant universities. Simulation, experiential learning and gaming provide mechanisms to engage students in competition, to enhance learning and to ignite a desire to confront the rigors of the business world (Lohmann *et al.*, 2019).

Research contributions

This paper will examine learning assurance results and performance outcomes for students enrolled at a medium-sized, private, master's level institution using a competitive online strategic management simulation. There has been "an absence of rigorous research supporting the learning effectiveness of experiential methods such as business simulations" (Anderson and Lawton, 2009, p. 201). This work advances this literature in several ways. First, only direct measures of learning assurance predictors and outcomes are examined, thereby permitting a rigorous assessment. For example, GPA and core course grades are correlated with simulation performance and learning assurance scores. Next, gender and academic major are examined as important variables in simulation performance and assurance of learning. Gender is particularly critical because of the "poets" and "quants" notion presumed to affect women and men in business education. Finally, this study seeks to measure learning over the entire business degree program showing how simulation learning assurance plays a role in overall program analysis.

Literature review

An important goal of education (Bloom, 1956), and management education in particular, is developing critical thinking skills (Athanassiou *et al.*, 2003; Kolb and Kolb, 2005;

Loveless *et al.*, 2016; Rousseau and McCarthy, 2007). Critical thinking outcomes have been identified as essential by specialized accreditation agency standards such as the Association to Advance Collegiate Schools of Business (AACSB International) (AACSB, 2013). According to the Academy of Management (AOM) and the Association for Business Simulation and Experiential Learning (ABSEL), business simulations are tools that can replicate decision-making the real-world business environment (Alstete and Beutell, 2016). Most simulation studies in AOM journals examine management, organizational behavior and strategic management applications (Halpin, 2013). Early research identified differences between general and functional business games (Cohen and Rhenman, 1961). The use of business games has grown from being supplemental to a central mode of instruction, from 71.1 per cent of AACSB schools in 1962 to 97.5 per cent in 1998 (Dale and Klasson, 1962; Faria *et al.*, 2009). Simulations are now a primary form of pedagogy in business education (Crowley *et al.*, 2017).

These realistic reproductions of business scenarios are more than just "fun and games" (Karriker and Aaron, 2014). Academics have found that student learning happens at all stages of the simulation experience "[. . .] from students' conceptualizing their corporation through a post-simulation review of their own performance" (p. 456) (Zantow *et al.*, 2005). Student perceptions about their simulation experiences indicate satisfaction with, and knowledge acquisition from, the competitive team environment. Also, engaging in frequent business decision-making might prepare participants to make better strategic choices. Researchers have found that simulations inspire deeper levels of learning than other pedagogies, including capability to grasp advanced business topics, forecast effectively, assess outcomes, consider multiple dimensions of managerial decision-making and work together with other students using analytical dialogue (Buzzetto-More and Mitchell, 2009). Simulations in business strategy courses have been found to promote complementary understanding of functional and integrative knowledge (Stephen *et al.*, 2002), a significant goal for business education.

Gresch and Rawls (2017) examined which undergraduate business courses are perceived as most useful in preparation a capstone simulation game. The courses most commonly identified as helpful are financial management (58.2 per cent), financial accounting (53.4 per cent), global business (42.3 per cent) and operations management (40.9 per cent). Other courses mentioned included marketing, managerial accounting and principles of management. This study also suggested that the simulation had a positive impact on the student's confidence for succeeding in the business world by developing learning skills that are valued by employers. A demonstrated connection between the use of business strategy simulations and key employability competencies would be valuable information for all stakeholders (Crowley *et al.*, 2017).

Other studies have shown that simulations are effective in developing critical thinking skills (Loveless *et al.*, 2016; Rousseau and McCarthy, 2007). Simulations that produce intended learning outcomes (ILOs indicate what students will gain as a result of successful learning) result in demonstrated increases in critical thinking (Bell and Loon, 2015). The hypothesis that students with stronger critical thinking skills would achieve better learning outcomes in business simulations was supported. These findings of Bell and Loon (2015) relate to dispositional critical thinking (i.e. critical thinking as a trait). Although the present study did not measure critical thinking directly, we argue that critical thinking skills are developed by participating in business simulations: discussion, evaluation and feedback stages of the simulation process (Lacruz, 2017; Reid and Anderson, 2012).

More research assessing *actual* student learning outcomes is needed to make meaningful program changes (Bacon and Stewart, 2016). Michlitsch and Sidle (2002) found that, although faculty members used appropriate methods for assigning grades, methods that might be more effective in overall assessment of business programs are used infrequently. Anderson and Lawton's (2009) literature review reported that there was a lack of "rigorous research supporting

the learning effectiveness of experiential methods such as business simulation" (p. 201). Further, previous studies relied too heavily on *perceptions* of learning or *perceptions* of behavioral change (Burns *et al.*, 1990; Gosenpud, 1990) rather than actual performance indicators.

In an earlier study, Wolfe (1990) argued that performance in the simulations has been used as a "proxy for course-related-knowledge gain, although the accuracy of this proxy relationship has never been investigated" (Wolfe, 1990, p. 229). More studies have been completed, but Wolfe's statement is still essentially correct. Andre (2016) has noted contradictory findings in the literature. Further, relatively few studies to date have attempted to elucidate the relationship between GPA and core grades on simulation performance (Andre, 2016). This paper examines this gap in the literature by including GPA and business core course grades. In addition, simulation learning should be embedded in the business degree program curricula by assessing learning effectiveness using criteria for sound research and objective measures (Gosen and Washbush, 2004).

Previous research on GLO-BUS indicated that students are provided with unique and rich contexts for the application of strategic management frameworks through an engaging and competitive simulation environment (Cotae *et al.*, 2016; Karriker and Aaron, 2014). Xu and Yang (2010) reported that social interaction and psychological safety had a positive impact on knowledge development in student groups. Further, there were synergistic effects aiding the formation of complex mental models (Xu and Yang, 2010). While the team aspects are important, the individual student elements (within the simulation and prior/concurrent grade performance) also need to be studied. Moreover, learning outcomes in the business curricula using simulations have not been given much attention in the literature.

Faria and Wellington (2005) noted that the validity of business simulations has been considered in several ways. Game performance measures have been compared to subsequent real-world business success. Further, performance measures can reveal how well students compare to each other and whether student decisions in the simulation relate to decision-making outside of the game (Faria and Wellington, 2005). Previous simulation research has considered team composition, including gender, team average GPA, business core grades, team-based behaviors and even system login usage (Andre, 2016; Apesteguia *et al.*, 2012; Schmeller, 2019). Andre (2016) used the GLO-BUS simulation to identify the influence of a student's previous academic performance, including GPA, business core course grades and team behaviors affecting simulation performance. The results showed that only two of the many marketing course commitment variables had predictive validity (Andre, 2016). Older studies of gender in team composition had mixed findings; some showing no relation between quantitative skills and simulation performance (Vance and Gray, 1967; Wolfe, 1978), while others implied that gender could be a factor (Lynch and Michael, 1989). Another study found that teams of three women performed worse than all other gender combinations. The optimal combination was two men and one woman (Apesteguia *et al.*, 2012).

Aside from team gender composition, a more recent study found that "there does not seem to be a significant difference between males and females in terms of their improvement in all of the skills" (p. 381) (Levant *et al.*, 2016), which partially confirms previous investigations (Stainbank, 2010), yet it is stated that this presents a need for further enquiries to explain the lack of consensus on gender impact in the research studies (Levant *et al.*, 2016). However, Latta *et al.* (2016) examined gender influences on assurance of learning scores from GLO-BUS and Educational Testing Service (ETS) Business Major Field Scores and found significant relationships within genders in a study of 95 undergraduate marketing major students at one public university (Latta *et al.*, 2016). Males were shown to exceed females on ETS scores and two GLO-BUS measures – leadership and financial analysis, as well as GLO-BUS scores for financial analysis, financial management, human resource management and marketing

management, with no significant correlations for females. This study will be one of the few found that examine GLO-BUS learning assurance measures (LAR) provided by a simulation learning assurance report (that compares results with students from other colleges and universities) and performance in the simulation itself, gender, academic major and core course performance. Furthermore, student simulation performance will be assessed and correlated with performance in the capstone business strategy course and overall GPA.

Research questions

Our study examines learning assurance measures, simulation performance, business core course grades, capstone course grades and overall GPA, gender and academic business major. Based on the foregoing literature, we propose the following research questions (RQs):

RQ1. Are there gender differences in LAR scores?

RQ2. Are there gender differences in performance measures (core course grades, simulation grade, capstone grade, GPA)?

RQ3. Are there differences between academic majors (e.g. accounting, management) for LAR scores?

RQ4. Are there differences between academic majors (e.g. accounting, management) on performance measures (core course grades, simulation grade, capstone grade, GPA)?

RQ5. Are LAR scores related to capstone business simulation performance?

RQ6. Are business core course grades related to LAR scores?

RQ7. Are business core course grades related to simulation performance?

RQ8. Are LAR scores associated with capstone course grades?

RQ9. Is capstone course grade related to cumulative GPA?

Method

Sample

The sample consisted of 595 undergraduate, senior-level business students enrolled in business policy and strategy capstone course sections. The sample included 248 women (42 per cent) and 345 men (58 per cent) (two students had missing data). The academic majors included accounting ($n = 129$, 24 per cent), business administration ($n = 11$, 2 per cent), finance ($n = 135$, 25 per cent), management ($n = 84$, 16 per cent), marketing ($n = 129$, 24 per cent), international business ($n = 32$, 6 per cent) and information systems ($n = 28$, 5 per cent). Note that 47 students did not indicate a major.

Measures

In addition to the gender and major identified above, the following variables were included: core business course grades, LAR scores, simulation grade (simulation grade), capstone course final grade (capstone grade) and cumulative GPA.

Core course grades. Grade for ten business core courses were recorded using the following scale: A = 4.0, B+ = 3.5, B = 3.0, C+ = 2.5, C = 2.0, D+ = 1.5, D = 1 and F = 0. The cores courses included the legal environment of business, management information systems, financial accounting, managerial accounting, business statistics, principles of management, principles of marketing, production and operations management and business

and society. An average core course grade was computed by summing the quality points and dividing by ten. Note that, unlike the capstone course, each of the core courses was taught by a variety of faculty.

Learning assurance. The GLO-BUS simulation provides nine empirical measures (see Table I) of student performance derived for making strategic business decisions. Three of these LAR scores are associated with individual performance (i.e. leadership skills, collaboration and teamwork and financial analysis). The remaining six dimensions are individual scores based on small team participation (i.e. financial management, operations management, marketing management, human resource management, strategic analysis and planning and corporate social responsibility). This study focuses on the individual level of performance. Learning assurance scores (percentiles) are based on performance of all participants in the simulation within the USA.

Capstone course grade. This was the final grade for the capstone course recorded the following grading scale: A = 4.0, B+ = 3.5, B = 3.0, C+ = 2.5, C = 2.0, D+ = 1.5, D = 1 and F = 0. Higher scores indicate better course performance. As GLO-BUS simulation company performance was included as 16 per cent of the final grade, our analyses controlled for the simulation component.

The simulation game counts 20 per cent of the overall course grade. The remaining assignments include ten required in-class oral case discussions (26 per cent), 12 online chapter quizzes (24 per cent), a team case presentation (10 per cent) and a written final exam (20 per cent). Within the internal GLO-BUS simulation game scoring system, there are individual student and team assignments that include an overall company score (80 per cent) that results in the 16 per cent of the course grade used in this study. The remaining 20 per cent (or 4 per cent of the course grade) of GLO-BUS includes two individual student quizzes and two three-year strategic plans (2.5 per cent each), team presentation (5 per cent) and self/peer evaluations (1 and 4 per cent). Students are assigned to work in teams of two or

Leadership skills	Assessment of the individual's leadership and independent thinking skills
Collaboration and teamwork	Assessment of the individual's collaborative skills, teamwork and ability to work well with others
Financial analysis	Assessment of the individual's skills in analyzing financial ratios and financial statements
Financial management	Assessment of the group's ability to apply financial management principles based on the company's ROE, credit rating and stock price performances
Operations management	Assessment of the group's ability to manage production operations and control production costs based on the company's production cost competitiveness as measured by production costs per unit (adjusted for product quality and product line breadth)
Marketing management	Assessment of the group's ability to effectively market the company's product and control marketing costs based on the company's market image and marketing costs per unit sold
Human resources management	Assessment of the group's proficiency in workforce management and controlling labor costs based on workforce compensation, workforce productivity and labor costs per unit sold
Strategic analysis and planning	Assessment of the group's strategic planning and strategic thinking skills based on scores achieved on the three-year strategic plan exercise
Corporate social responsibility	Assessment of the group's awareness of and commitment to operating the company in a socially responsible manner and being a "model corporate citizen" based on the percentage of company revenues spent on the six corporate social responsibility initiatives

Table I.
GLO-BUS LAR definitions

three that compete against other company teams in each course section that is a simulated competitive industry.

Cumulative grade point average. This was the overall grade point for all undergraduate courses attempted by the participants. Once again, a four-point grading system was used where an A = 4.00. Higher scores indicate better overall academic performance.

Procedure

The students enrolled in the business strategy capstone course sections during a four-year period from 2015 to 2018 were assessed. The courses were offered at an AACSB-accredited business school at a medium-sized, US private college, in a large metropolitan area. The same full-time, tenured management professor taught all of the course sections. All students were required to participate in the GLO-BUS simulation game provided by McGraw–Hill publishing. GLO-BUS is packaged with a required course textbook that examines the strategic management concepts that are coordinated with applied decision-making in the simulation game and real-world business cases.

During the first week of each semester, the professor lectures on how to play the game and provides detailed information such as a participant's guide and videos. Each week simulates one year of company operation, and there are two weeks of practice before the graded portion of the simulation begins. The simulation is then conducted over ten consecutive weeks (simulated years) until the conclusion. The students are debriefed after each week's (year's) performance, and after the simulation, all students are required to make a presentation on their company's performance and explain the most important lessons learned. The winning student team members are awarded certificates and are given the option to be exempted from the final exam to enhance performance motivation. All enrolled students participated in the GLO-BUS simulation. Student names were removed from the database to preserve privacy and confidentiality. The Institutional Review Board (IRB) indicated that this study was exempt because it was deemed programmatic evaluation.

Results

Table II reports the means, standard deviations and correlations for the major study variables. There are a few things to note about the correlation matrix. Financial analysis was related to human resource management ($r = 0.11$, $p < 0.01$), strategic analysis ($r = 0.32$, $p < 0.01$) as well as academic performance measures. Financial management was significantly related to marketing management ($r = 0.30$, $p < 0.01$), human resource management ($r = 0.39$, $p < 0.01$), strategic analysis ($r = 0.59$, $p < 0.01$) and academic performance measures: Simulation grade ($r = 0.83$, $p < 0.001$), capstone grade ($r = 0.28$, $p < 0.01$) and GPA ($r = 0.21$, $p < 0.01$). However, financial management was inversely related to CSR ($r = –0.17$, $p < 0.01$). Note the generally strong, positive correlations between simulation grades and LAR scores with exceptions, including leadership, teamwork, operations management, and the inverse relationship with CSR.

RQ1 focused on gender differences in LAR variables. Gender was entered as an independent variable in a multivariate analysis of variance (MANOVA). LAR scores served as dependent variables. None of the differences was statistically significant. The findings suggest no evidence of gender differences in LAR scores.

Gender differences were also examined for academic performance measures (core course grades, simulation grade, capstone grade, GPA) (*RQ2*). Women scored higher than men on all ten core courses. Based on a MANOVA using gender as the independent variable, the following differences were statistically significant: legal environment of business ($p < 0.001$),

Table II. Means, standard deviations and Pearson correlations for major study variables

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Leadership	70.18	28.08												
2. Teamwork	72.38	28.42	0.82**											
3. Financial analysis	34.53	31.21	0.05	0.03										
4. Financial management	60.17	21.42	–0.01	0.05	0.05									
5. Operations management	59.06	27.13	–0.00	0.03	–0.02	0.03								
6. Marketing management	55.42	19.97	0.02	0.01	–0.03	0.30**	–0.13**							
7. Human resource management	44.13	28.62	0.06	0.08	0.11**	0.37**	0.12**	0.15**						
8. Strategic analysis	43.83	23.35	0.04	0.01	0.32**	0.59*	–0.08	0.33**	0.26**					
9. Corporate social responsibility	49.91	28.44	0.02	0.05	–0.05	–0.17**	–0.12*	–0.24**	–0.09*	–0.16**				
10. Simulation grade	83.10	16.02	0.07	0.08	0.12**	0.83**	–0.03	0.44**	0.47**	0.65**	–0.22**			
11. Capstone grade	3.25	0.41	0.21**	0.19**	0.12*	0.26**	–0.03	0.08*	0.12**	0.25**	–0.13**	0.37**		
12. GPA	3.29	0.47	0.24**	0.23**	0.17**	0.19**	0.03	0.03	0.06	0.18**	–0.04	0.23**	0.55**	
13. Core course average	3.30	0.47	0.21**	0.17**	0.13*	0.19**	0.06	0.05	0.05	0.13**	–0.04	0.20**	0.41**	0.88**

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$; GPA = grade point average (cumulative); Core course average = average for all core courses

management information systems ($p < 0.05$), statistics ($p < 0.01$), principles of management ($p < 0.01$), principles of marketing ($p < 0.01$) and business and society ($p < 0.001$).

For other performance measures (*RQ2*), MANOVA results revealed that women scored significantly higher on capstone course grade ($F(1,399) = 7.42$, $p < 0.05$) ($M = 3.39$, $SD = 0.85$ for women, $M = 3.14$, $SD = 0.89$ for men) and overall GPA ($F(1,399) = 28.52$, $p < 0.001$) ($M = 3.42$, $SD = 0.38$ for women, $M = 3.20$, $SD = 0.40$ for men). There was no difference between women and men on GLO-BUS simulation performance. Overall, there is moderately strong evidence of gender difference in core business courses, capstone grade and GPA, but no difference with respect to simulation scores.

Differences in LAR scores based on major field of study in business were examined (*RQ3*). Major was entered as an independent variable and LAR scores as dependent variables (MANOVA). Significant differences were found for financial analysis ($F(5,506) = 3.04$, $p = 0.01$), financial management ($F(5,506) = 2.37$, $p < 0.05$), marketing management ($F(5,506) = 2.19$, $p = 0.05$), strategic analysis ($F(5,506) = 4.70$, $p < 0.001$) and corporate social responsibility ($F(5,506) = 2.72$, $p < 0.05$). Tukey *post hoc* tests revealed that, for financial analysis, finance majors ($M = 42.71$, $SD = 33.62$) were significantly higher ($p < 0.05$) than marketing majors ($M = 31.32$, $SD = 29.95$). For financial management, accounting majors ($M = 62.69$, $SD = 21.93$) were significantly ($p < 0.05$) higher than international business majors ($M = 52.53$, $SD = 22.68$). For marketing management, finance majors ($M = 59.38$, $SD = 19.08$) were significantly higher ($p < 0.05$) than marketing majors ($M = 51.96$, $SD = 20.65$). For strategic analysis, finance majors ($M = 51.34$, $SD = 23.57$) were significantly higher than accounting ($M = 40.74$, $SD = 23.35$, $p < 0.01$) and marketing ($M = 39.98$, $SD = 22.11$, $p = 0.01$) majors. Finally, for CSR, international business students ($M = 63.00$, $SD = 28.200$ were significantly ($p < 0.05$) higher than information systems majors ($M = 40.70$, SD = 29.45). There are moderate differences in LAR scores based on the academic major field.

RQ4 investigated academic major in relation to performance measures (core course grades, simulation grade, capstone grade, GPA). MANOVA was used for this analysis. The results revealed significant differences for core course grades ($F(5,399) = 12.82$, $p < 0.001$), simulation grade ($F(5,399) = 3.29$, $p < 0.01$) and GPA ($F(5,399) = 6.76$, $p < 0.001$). There was no difference for capstone course grade by major. Tukey *post hoc* tests indicated that finance majors ($M = 17.09$, $SD = 3.93$) scored significantly ($p < 0.05$) higher than marketing majors ($M = 15.41$, $SD = 3.61$) on simulation grade. Accounting majors (GPA = 3.46, SD = 0.35) scored significantly higher than international business ($M = 3.14$, $SD = 0.43$, $p = 0.001$), management ($M = 3.13$, $SD = 0.41$, $p < 0.01$), marketing ($M = 3.13$, $SD = 0.50$, $p < 0.05$) and majors on overall GPA. Academic business major field differences in performance indicators were moderate.

Are LAR scores related to simulation grade (*RQ5*)? Multiple regression was used in this analysis. LAR scores were regressed on simulation grade by entering all scores at once. LAR scores significantly related to simulation grade ($F(9, 552) = 242.58$, $p < 0.001$; $R^2 = 0.80$, $p < 0.001$). Next, LAR scores were entered in a stepwise fashion to determine the strongest relationships with simulation performance. Financial management had the strongest relationship overall ($\beta = 0.59$, $p < 0.001$), followed by strategic analysis ($\beta = 0.21$, $p < 0.001$), human resource management ($\beta = 0.19$, $p < 0.001$) and marketing management ($\beta = 0.20$, $p < 0.001$). LAR scores are strongly related to simulation grades, with financial management having the strongest relationship.

Are LAR scores related to business core course grades (*RQ6*)? First, we did a multiple regression using LAR scores as independent variables and the average of ten core courses as the dependent variable. Three LAR dimensions were significantly related to average core course grades: leadership ($\beta = 0.21$, $p < 0.01$), financial analysis ($\beta = 0.16$, $p < 0.01$) and financial management ($\beta = 0.20$, $p < 0.001$). Next, we considered LAR scores for each core

course using multiple regression controlling for gender. The results indicated that financial analysis and financial management LAR dimensions were significantly related to five core courses: legal environment of business, financial accounting, statistics, principles of marketing and production and operations management. Leadership was significantly related to the legal environment of business, managerial accounting and principles of finance courses. Corporate social responsibility was related to the management information systems course. None of the LAR scores was related to the business and society core course. There is evidence to support the relationship of LAR scores and core course grades.

Are business core course grades related to simulation performance (*RQ7*)? Core course grades were regressed on simulation performance. All courses were entered simultaneously as predictor variables to control for associations between courses. The overall regression equation was significant ($F(10, 426) = 3.66$, $p < 0.001$). The results indicated two courses were significantly related to capstone performance: principles of marketing ($\beta = 0.12$, $p < 0.05$) and production and operations management ($\beta = 0.15$, $p < 0.01$). The findings suggest some relationship between core course grades and simulation performance.

Are LAR scores related the capstone course grade (*RQ8*)? LAR scores were regressed on capstone course grade. This overall regression analysis was significant ($F(9, 519) = 9.42$, $p < 0.001$). Two LAR dimensions were significantly and positively related to capstone course grade: leadership ($\beta = 0.15$, $p < 0.05$) and financial management ($\beta = 0.19$, $p < 0.001$). Corporate social responsibility was inversely related to capstone course grade ($\beta = -0.11$, $p < 0.05$). LAR scores do have some relationship to capstone course grade.

RQ9 examined capstone grade in relation to GPA. Linear regression was used for this analysis, with GPA as the dependent variable and capstone grade as the independent variable. The analysis was highly significant ($F(1,552) = 234.35$, $p < 0.001$, $\beta = 0.55$, $R^2 = 0.29$). As women had higher capstone grades and overall GPAs, we repeated this analysis controlling gender. The relationship was still highly significant ($F(2, 551) = 217.97$, $p < 0.001$, $\beta = 0.52$, $R^2 = 0.33$). This supports the relationship between capstone grade and overall academic performance (GPA).

In summary (see Table III), *RQ1* found no evidence of gender differences in LAR scores. Women scored higher than men for most performance measures, but there was no difference for GLO-BUS simulation performance (*RQ2*). *RQ3* found moderate differences in LAR scores for different academic majors. For performance measures, differences by major were found for

RQ Number	Variables	Findings
RQ1	Gender and LAR	No differences
RQ2	Gender and performance	Women higher than men on core, capstone and GPA; no difference in simulation performance
RQ3	Major and LAR	Moderate differences in LAR by major
RQ4	Major and performance	Differences in performance except for capstone grade; finance and accounting had strongest relationships
RQ5	LAR and simulation grade	LAR and simulation grade strongly related; financial analysis and strategic management strongest relationships
RQ6	Core courses and LAR	Main LAR dimensions related to core courses: financial management, financial analysis and leadership
RQ7	Core courses and simulation	Two courses related to simulation performance: marketing and production and operations management
RQ8	LAR and capstone course grade	Two LARs relate to capstone grade: leadership and financial management
RQ9	Capstone grade and GPA	Strong relationship between capstone grade and overall GPA

Table III.
Brief summary of findings for each RQ

core courses (accounting had significantly higher core course grades), simulation performance (finance performed highest and significantly higher than marketing) and cumulative GPA (accounting was highest and significantly higher than international business, management and marketing), but majors did not differ on capstone course grades (*RQ4*). *RQ5* indicated that LAR scores were related to simulation grade (financial management had the strongest association). *RQ6* found that LAR scores were related to business core course grades. *RQ7* revealed that business core course grades and simulation performance are related. *RQ8* showed a relationship between LAR scores and capstone course grade. Finally, *RQ9* found that capstone grade and GPA are significantly and positively related.

Discussion

Management educators have been increasingly interested in student learning outcomes stimulated by instructional methods that actively engage students. Online simulations have been used for many years without much solid empirical research about learning assurance measures and analysis of student performance characteristics. Our analysis of the GLO-BUS simulation results supports the use of this instructional method as part of a carefully planned capstone course curriculum and contributes to the literature in this field (Alstete and Beutell, 2016). The strong correlation between the simulation grade and LAR dimensions is understandable and likely attests to the validation of the simulation game. This also supports previous studies reporting that undergraduate courses in financial management and accounting are most useful for successful participation in a simulation game (Gresch and Rawls, 2017).

The findings on gender are interesting and important. There was no evidence of gender differences in LAR outcomes, but women score significantly higher on performance measures than men with the notable exception of GLO-BUS simulation performance. Similar gender differences for business students have been reported in other studies (Kaighobadi and Allen, 2008). Yet, other research on the GLO-BUS simulation indicates that men tend to score higher on learning assurance dimensions than women business students (Latta *et al.*, 2016). (Note that the sample size in the Latta *et al.* (2016) study was much smaller than that used in the present study.) This suggests the possibility that the reported gender differences are not stable, or that a larger sample may not have shown such differences. Juxtaposing our findings with those of Latta *et al.* (2016), along with the presumed "gender gap" in MBA programs, suggests the possibility that women are "poets" and men are "quants" (Wallen *et al.*, 2017). The fact that women in this study scored higher than men on business core courses (including statistics), capstone course grade and overall GPA seems to counter this notion. And, most significantly, there was no difference between women and men for GLO-BUS simulation performance. More research is clearly needed, but gender similarity in simulation performance is notable. Further, the evidence from this study supports the connection between the use of business strategy simulations and key employability competencies identified in the literature (Crowley *et al.*, 2017) for women *and* men.

The aforementioned study by Wolf (1990) stated that simulations have been used for many years as a proxy for gains in course-related knowledge, yet the accuracy of this statement has never been fully investigated. The present findings reveal significant relationships between GLO-BUS simulation performance and final course grades (capstone grades) as well as associations with cumulative (overall) GPA. The other results from this study indicate differences in learning outcomes based on student major. This argues that faculty members should probably seek a mix of business majors on student learning teams to possibly improve learning results. The findings that the learning assurance results are strongly related to simulation grades (with financial management having the strongest association) validates the suggestion that simulations (such as GLO-BUS) rely heavily on understanding the financial

ratios and financial analysis to inform strategic management decisions. Yet, other functional areas are also important. This argues that strategic indicators that go beyond financial outcomes must also be incorporated into curriculum planning.

The authors believe that the post-simulation debates as mentioned by Zantow *et al.* (2005) are important and contribute positively to learning outcomes, but further research is needed. In addition, more research should be conducted that examines student team learning assurance results as well as comparisons of delivery methods. Distance education, hybrid partially online and on-campus course modes of delivery should be thoroughly studied in conjunction with the use of competitive business simulations to better understand proper construction of business courses and curriculum.

Our study does have several limitations. Simulation grades comprised 20 per cent of the final capstone course grades, indicating a degree of criterion contamination. Other limitations include the use of one particular online competitive simulation game (GLO-BUS), analysis of students at one institution, the learning assurance measures, using percentile scores, course grades that combine individual and team assignments (although this is a common feature of many courses in business degree programs) and using a limited number of individual student variables (gender, capstone course grade, cumulative GPA and degree major). Note also that future research should attempt to remedy these limitations and possibly confirm and extend these findings by conducting longitudinal studies. Simulation game performance could be analyzed in relation to subsequent graduate school performance and career achievements.

Notwithstanding these limitations, the present findings focused on actual student performance data rather than attitudes or feelings about performance. Our results suggest several inferences for effectively planning and using simulations in capstone business courses. The manner in which active learning fits into the schema of undergraduate business curricula, including the required strategic management course, but also the overall program course sequence (e.g. core courses). As more faculty integrate simulations in functional area courses, as well as business policy and strategy, understanding how the simulations interact with internal and external variables will become increasingly important. Furthermore, this study adds to the literature on the internal and external validity of student learning measures within capstone courses that typically include traditional lectures and the well-established case method. This "triad" of course pedagogies may become, perhaps already has to some extent, the backbone of effectively accommodating different student learning styles in the business curricula.

Conclusion

This study represents an empirical analysis of simulation learning focusing on individual student characteristics (gender, business major), learning assurance dimensions, simulation performance, business core course performance and overall student GPA. The findings add to the literature on gender, major and business core course performance as factors related to effective strategic decision-making. As such, simulations foster deep levels of student learning by integrating the functional areas of business (Buzzetto-More and Mitchell, 2009; Stephen *et al.*, 2002) and potentially bridging the learning–doing, theory–practice gap. As stakeholders of business education continue to demand more accountability, including graduates with critical thinking skills that can be applied in organizational settings, simulation learning is crucially important in its own right but also as a complement to lectures and case studies.

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