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# The impact of a simulation game on operations management education

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ABSTRACT

This study presents a new simulation game and analyzes its impact on operations management education. The proposed simulation was empirically tested by comparing the number of mistakes during the first and second halves of the game. Data were gathered from 100 teams of four or five undergraduate students in business administration, taking their first course in operations management. To assess learning, instead of relying solely on an overall performance measurement, as is usually done in the skill-based learning literature, we analyzed the evolution of different types of mistakes that were made by students in successive rounds of play. Our results show that although simple decision-making skills can be acquired with traditional teaching methods, simulation games are more effective when students have to develop decision-making abilities for managing complex and dynamic situations.



## 1. Introduction

The present generation of college and university students has never experienced a world without personal computers (PCs). Many have spent much time playing computer games and are now very skilled at learning and applying complex sets of rules through game playing. According to Proserpio and Gioia (2007), the learning style of the new 'virtual generation' (V-gen) is very different from that of former generations. It is much more visual, interactive, and focused on problem-solving. While this could be seen as a threat to the traditional teaching style, based on verbal knowledge transfer and Socratic debates, it could also be seen as an opportunity to develop simulation games that build on V-gen skills and encourage the learning of management principles and practices.

Simulation games are but one way to acquire knowledge; we do not suggest that they can or should replace lectures, readings, case studies or other learning methods, which have been applied. They have also been around for many years, long before PCs were widely available. Nevertheless, now that a large proportion of students own powerful and interconnected laptops, it is easy to consider simulation games as an alternative to other types of problem-solving activities, one that can provide a complex and rich virtual environment conducive to deep learning.

First applied in training in the military and the aeronautics industry, simulation games are now used in the teaching of medicine, nursing, engineering, management, and several other fields. A growing body of literature describes new simulation games and measures their impact on student learning. This article will begin with a review and integration of the existing literature, focusing particularly on the various methods used to assess learning. To contribute to the current literature, the article will also present a new simulation game and analyze its impact on operations management education.

The article is organized as follows: Section 2 presents an overview and synthesis of current literature; Section 3 introduces the new simulation game; Section 4 presents the methodology used to evaluate its efficacy; and Section 5 details and analyzes the results. The article concludes with a brief discussion of the limitations of the research and the next steps to be considered.

## 2. Literature review

### 2.1. Defining simulation games

Clark (2009) asserts that "authors use different terminologies to define business simulation technologies that range from top management, flight simulators, business simulators, simulation games, macro-worlds/micro-worlds to learning laboratories." The confusion

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**Table 1**
Examples of research measuring reaction outcomes (including perceived learning) of a simulation game.

| Authors | Type of research | Results |
|---|---|---|
| Arias-Aranda and Bustinza-Sanchez (2009) | Compared simulation games with traditional teaching method; undergraduate students in business management ($n = 467$); questionnaire with closed questions. | Students reported a positive impact on personal control and self-esteem. |
| Battini et al. (2009) | Asked participants to evaluate their learning experience after a logistics simulation game; engineering students ($n = 252$); questionnaire with closed questions. | Students reported a high or very high degree of learning for all 9 items measured. |
| Betts & Knaus (2006) | Compared simulation games with cases and exercises; undergraduate students in business management ($n = 54$); questionnaire with closed questions plus open discussions. | Students thought the simulation game was superior to cases and exercises. |
| Cook and Swift (2006) | Compared simulation games with textbook used in class; undergraduate students in sales management ($n = 151$); questionnaire with closed questions. | Students rated the simulation game higher than the textbook for all 15 items measured. |
| Farrell (2005) | Compared simulation games with traditional teaching method; undergraduate students in business management ($n = 30$); questionnaire with closed questions. | Students perceived the simulation game as a more effective learning tool. |
| Lainema and Hilmola (2005) | Asked participants to evaluate their learning experience after an operations management simulation game; students in operations management ($n = 31$); questionnaire with closed questions. | Students evaluated the game very positively for four of the 14 items measured. |
| Li, Greenberg, and Nicholls (2007) | Compared simulation games with lecture-centered approach; MBA students ($n = 588$); questionnaire with closed questions | Students thought the simulation game was superior to a lecture-centered approach. |
| Romme (2003) | Asked participants to evaluate their learning experience after a management simulation game; MBA and business administration undergraduate students ($n = 252$); standard post-course evaluation form and questionnaire with closed and open questions. | Students perceived to have learned a lot during the simulation. In each population, the overall rating of the course was better than the program's average overall rating. |
| Tompson and Dass (2000) | Compared two groups of undergraduate strategic management students, one learning with a simulation game ($n = 126$), the other with case studies and lectures ($n = 126$); questionnaire with closed questions administered at the beginning and end of the course. | Students learning with simulation game showed a higher increase in self-efficacy evaluations, regarding both knowledge and skills. |

between games and simulations seems to have always been present (Ellington, Addinall, & Percival, 1981; Lewis & Maylor, 2007). Although there have been many attempts at clarification, it is still important to stress the differences between the two concepts and to define a simulation game. Webster defines a simulation as "the representation of the behavior or characteristics of one system through the use of another system, esp. using a computer." In other words, simulation refers to the representation of an aspect of reality based on a simplified and abstracted model. The *Oxford English Dictionary* provides a definition that can readily be applied to a learning environment:

> The technique of imitating the behavior of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, especially for the purpose of study or personnel training.

Bloomer (1973, as cited in Ellington et al., 1981, pp. 15–16) defines a game as "*any contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning, victory or pay-off).*" A game is thus an opportunity to use one's skills and compete with others. The name also suggests a stimulating and enjoyable activity, even though in a pedagogical context games should not be used mainly for amusement; indeed, Abt (1970) refers to pedagogical games as "serious games." A simulation is not necessarily a game. For instance, the simulations used by Holzinger, Kickmeier-Rust, Wassertheurer, and Hessinger (2009) in their empirical study of medical education consisted of interactive animated virtual representations of complex physiological models. The students had no personal decisions to make but could, for example, visualize the impact of different values of pressure gradient, radius and bifurcations on arterial blood flow. In operations management research, simulations are also often used to anticipate the possible results of alternative designs or changes made to a complex system. Games also commonly exist outside of simulated situations (for example, hopscotch, hockey, solitaire). Ellington et al. (1981, p. 16) thus define a simulation game as "*an exercise that possesses the essential characteristics of both games (competition and rules) and simulations (ongoing representation of real-life).*"

Simulation games may be used for various purposes. van der Zee and Slomp (2009) assert that they could help workers find solutions for specific problems, or to familiarize themselves with and ease their acceptance of new work methods or systems. Wolfe (1993) explores their application in laboratory research, where they can be used to evaluate human reactions in particular situations. The focus of this paper, however, is on the pedagogical use of simulation games. They are thus defined as challenging interactive pedagogical exercises, wherein learners must use their knowledge and skills to attain specific goals, played within an artificial reproduction of a relevant reality.

### 2.2. A brief history and overview

Simulations and games have long been used for training purposes. Wolfe (1993) traces their origins to war games that were used in ancient China. War games, mostly in the form of board games such as chess, have always been very popular. They were transformed into more serious- and more complex-games in Germany during the 17th century, and war games helped prepare and test tactical moves during World Wars I and II (Wolfe, 1993). Web-based versions, well suited to distance learning, are now used to train military strategists (Keh, Wang, Wei, Hui & Wu, 2008). In a related field, flight simulators are almost as old as the first airplane, and were used extensively during World War II to train fighter pilots (Moroney & Moroney, 1999). More recent simulators reproduce the cockpits of commercial airplanes such as the Boeing 747 and simulate normal and extreme flying conditions.