Simulation Modelling Practice and Theory 17 (2009) 1241–1253

Contents lists available at ScienceDirect

Simulation Modelling Practice and Theory

journal homepage: www.elsevier.com/locate/simpat

A flexible web-based simulation game for production and logistics management courses

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ARTICLE INFO

Article history:
Received 17 July 2008
Received in revised form 9 February 2009
Accepted 22 April 2009
Available online 6 May 2009

Keywords:
Simulation games
Production management
Logistics management
Supply chain management
Teaching strategies

ABSTRACT

This study develops a flexible simulation game environment called SIMPLE (Simulation of Production and Logistics Environment) in order to raise teaching effectiveness and improve classroom teaching in emerging production paradigms. Instructors can tailor SIMPLE by simply setting the appropriate parameters. SIMPLE can thus be adopted at various teaching stages to teach different major business concepts, such as inventory management, capacity management, pricing determination and negotiation, and information-sharing between players. Meanwhile, SIMPLE was employed in two courses to evaluate the degree of students' acceptance of using SIMPLE in classrooms. The results also showed that SIMPLE was generally well received by students.

1. Introduction

Instructors of decision sciences courses such as production management, logistics management, and supply chain management often are confronted with the challenge of continuously developing and adopting novel teaching methods to help students prepare for their professional careers. Additionally, instructors also are facing the challenge of motivating students with real-life scenarios in which several subjects are integrated within one study discipline. For example, determining the production quantities over time for a factory may involve at least the decisions of demand forecasting, resource allocation, machine scheduling, and inventory policy determination. Moreover, most universities are under sustained pressure to decrease instructional costs, even when most enterprises in industry prefer to recruit people who have multi-functional abilities in order to increase their market competitiveness.

To improve teaching effectiveness in these emerging production paradigms, new teaching aids are being proposed to help students gain a new understanding of real industries and enable them to employ the knowledge and theories that are obtained from classrooms in the real world. These teaching aids include gaming tools, which not only foster competition among students, but also bring excitement to the learning process. Instructors have successfully applied different games in class in recent years while teaching production management and other similar courses [21,17,1]. Additionally, games have been revealed to be very useful pedagogical methods for supplementing conventional teaching techniques.

Regarding the different roles of instructors and students when the game is adopted, some production management and other related course games are designed for the needs of a single course or certain teaching topic [9,11,15]. Therefore, when instructors use games to assist in teaching, they require different games based on the needs of the course [24]; students must learn the rules and determine the strategy of different games for different courses. The demand that is placed on preparation

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doi:10.1016/j.simpat.2009.04.009

time of instructors is increased through game requirements, which threaten the instructor's willingness to adopt game-assisted instruction.

This study develops a flexible game environment called SIMPLE, which stands for SIMulation of Production and Logistics Environment. SIMPLE is a web-based object-oriented game environment that simulates various decision-making scenarios that often are observed in production, logistics, and supply chain management. The aim of this study is to build a flexible game environment as a teaching aid to increase the instructional effectiveness in production, logistics, and supply chain management and related courses. Meanwhile, SIMPLE can also be used as a test-bed to test/evaluate new rules, methods, and theories in a controlled, artificial environment.

2. Production/logistics game

In recent years, games have been proven to be an effective tool in supplementing traditional teaching methods [22,14,4]. Games are a goal-directed, challenging, and competitive activity that is conducted within a framework of agreed rules to provide a playful learning environment [1,8,16,17]. The use of games enhances the richness of learning and improves learning efficiency; games can provide experience in the application of theory and concepts as well as improve a student's capacity to think [20]. An additional goal is educating students in new methods of aggressive learning, which enables them to combine theory and practice to construct new concepts that are learned from course content in the classroom. Therefore, more and more instructors use the method of game playing to construct classroom situations so as to enhance the learning motivation of the students [22,23,18]. Especially, instructors in production management, logistics management, and other decision sciences courses adopt game-assisted teaching tools to simulate real enterprise situations so as to let students prepare for their professional careers.

The first (and best known) production/logistics game is the Beer Game, which was originally developed by the Massachusetts Institute of Technology (MIT) in the 1960s. The aim of the Beer Game is to reveal how people's decision patterns in production, logistics, and customer chains sometimes produce unexpected and undesired results. The game was first played on a board like a card game and later was transferred to a computerized environment. Several other games were developed after the Beer Game to challenge students' reactions and to develop their management skills. Several web-based games have now been developed and have been adopted not only in the classroom to facilitate learning, but also in other circumstances to stimulate research by bringing international competition and collaboration among students, instructors, and researchers. Table 1 shows several well-known web-based games in production and logistics management.

A special interest group for the development of games for production and logistics management was formed in the early 1990s. The Special Interest Group, under IFIP Working Group 5.7 on Integrated Production Management, seeks to encourage the development and application of simulation games for production management in education and industry. The group concluded that one of the lessons learned from applying games in teaching is the requirement of adopting different types of games. No single game can be successfully applied to all learning situations. Additionally, the group concluded that attention should be paid to motivating and enhancing the instruction of production and logistics management because of high

Table 1
List of the production and logistics simulation games.

Name of the game	Description	Decision Scope	Developer
MIT Beer Game http://www.beergame.mit.edu/	Beer production and distribution in a multi-stage distribution channel	Act as manufacturer, distributor, wholesaler, or retailer to determine production or ordering quantities	Massachusetts Institute of Technology, USA (1988)
Columbia Beer Game	Beer production and distribution in a multi-stage distribution channel	Act as manufacturer, distributor, wholesaler or retailer to determine production/order quantities (similar to MIT beer game but with stochastic customer demand)	Columbia University [6]
Hulia Game http://www.hulia.haifa.ac.il/Eng/hulia.html	Beer production and distribution in a multi-stage distribution channel	Act as manufacturer, distributor, wholesaler, or retailer to determine production or order quantities	The University of Haifa, Israel (2000)
Trading Agent Competition http://www.sics.se/tac	Online bidding on multiple markets simultaneously	Act as an agent to manufacture PCs, win customer orders, and procure components	Swedish Institute of Computer Science (2003)
Littlefield Technology http://www.littlefield.responsive.net	Manufacturing simulation in made-to-order assembler of electronic systems	Act as a manufacturer to determine utilization, queuing, scheduling, and inventory	Stanford University, USA (1996)
The Logi-Game http://www.moltho.dk	Simulation game of material flows in a distribution channel for bicycle industry	Act as manufacturer, wholesaler, or retailer to make manufacturing and inventory decisions	Technical University of Denmark
Supply Chain Game http://www.factory.isye.gatech.edu/research/	Production and distribution simulation in automobile industry, including manufacturers, transporters, and suppliers	Act as decision-maker in a competitive supply chain framework, such as a supplier or assembler	Georgia Institute of Technology