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Developing supply chain competencies through experiential learning and games

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Abstract

The Supply Chain Management field has a shortage of talent to deal with the complex problems organizations face nowadays. Higher education institutions have worked to close the gap in knowledge and competencies with various results. This paper presents the results of implementing a Supply Chain Management course, which includes experiential learning, gaming, and industry-academia collaboration to develop four competencies in this field. The main results show how the relevance of hands-on learning, the variety of learning environments -such as virtual, simulated, and real- and tutoring from both practitioners and professors from different disciplines become key elements in developing the required skills to perform a role in a Supply Chain related position.

Keywords: *Experiential learning; role-playing game; learning environments; supply chain competencies; competencies development.*

1. Introduction

Nowadays, market trends' dynamics are affecting the organizations' configuration and operation of supply chains. Constant and ever-faster changes in markets, economy, finance, and technology encourage supply chain evolution in collaboration, configurations, and management. Moreover, including Internet of Things (IoT) technologies or adopting cyber-physical systems has accelerated the innovation in supply chain operations to meet customer needs (Garay-Rondero *et al*., 2020). Similarly, globalization has changed how the industry competes due to global sourcing, cultural challenges, the interactions among and between nations, and how all these factors affect the production of goods and services (Fernando and Wulansari, 2021).

On the other hand, graduates that enter a related supply chain position in the industry have been showing gaps between academic training and the industry requirements. For these people, the required skillset includes the capability of dealing with uncertainty, dealing with non-routine situations, adapting to rapid changes in the work environment, flexibility, and adapting to dynamic work requirements, among others (Al-Shammari, 2022). Additionally, companies face significant challenges in recruitment, retention, and succession of the few able talents, mainly due to the combination of competencies required and the level of interaction needed within and across the organization to create value for all the stakeholders (Flöthmann et al., 2018).

Considering this scenario, this paper presents the findings after implementing a supply chain management (SCM) course involving active learning didactic strategies, information technology aids, and dual learning to develop SCM competencies at the undergraduate level. The remaining of the paper is as follows: section two briefly presents a theoretical background on supply chain talent requirements and current teaching innovations; section three describes the methodology followed to develop supply chain competencies in the students; section four shows the results obtained during the implementation of the course; section five includes the discussion results, and section six summarizes the conclusions and recommendations for future work.

2. Theoretical Background

Developing supply chain competencies has been relevant for over twenty years. However, the supply chain operations' complexity emanating from a changing business environment, globalization, and technological advances has raised hurdles in meeting the industry requirement for SCM professionals, who additionally need to develop skills to perform planning and strategic functions and not just carry on transactional or office tasks (Prajogo and Sohal, 2013). Recent studies indicate a factor of one to six between the SCM professionals supplied by higher education institutions and industry needs. This proportion

does not consider the effectiveness of the training nor its alignment with the competencies required for current SCM-related positions (Birou *et al.*, 2022). Furthermore, supply chain professionals have become a source of competitive advantage to organizations, so a lack of talent is considered a relevant cause of supply chain risk (Dubey and Gunasekaran, 2015). Thus, focusing on developing SCM competencies at the undergraduate level becomes critical for an organization. The following subsections briefly describe previous research on the need for SCM competencies in the current related positions and preceding academic efforts to develop them.

2.1. Supply Chain Competencies

There is no unique classification or consensus about the skills required for SCM professionals. For instance, Sun and Song (2018) recognized that the SCM field is continuously evolving, such that it is becoming more interdisciplinary as the business environment is more complex every day. After a thorough literature review, they classified the SCM skills required by the professional field. They included technical knowledge and soft skills requirements such as communication and teamwork, self-management and improvement, and social responsibility. Conversely, Birou et al. (2022), based on a review of 109 courses, found 120 related topics, of which 18% appeared once throughout these courses, concluding that there is no clear consensus about the SCM field coverage. Finally, Sweeney *et al.* (2010) remark on preparing future professionals to use sophisticated SCM software to deal with problem complexity, efficiently use the information, and support the decision-making processes. This broad scope makes it difficult to define a clear set of skills to be covered in a course. Moreover, the contents may change between an engineering program course and a business course.

2.2. Academic Efforts in Developing SCM Competencies.

Regarding academic efforts to provide an adequate environment for developing supply chain competencies, the literature shows a variety of scopes. For instance, Pepper and Clements (2008) used a role-playing approach to provide the "learner" with a structured methodology, allowing individual learning outcomes to be accomplished through scenario-based activities. The applied simulation exercise provided an environment for experiential learning and problem-solving at a pace defined by the learner. Results showed benefits related to complexity understanding, communication, and adaptation to changing scenarios. Similarly, Sweeney *et al.* (2010) used specialized software to provide experiential learning in a more realistic and significant context for understanding key management concepts. The authors highlighted the benefits and challenges of designing courses based on specialized supply chain software. Likewise, Gámez-Pérez *et al*. (2020) proposed a collaboration model to develop supply chain competencies through experiential learning, international experiences, and collaboration between two universities in different countries and industries. Their

findings include the need to promote closer collaboration between academics and practitioners to generate an understanding of the needs, competencies, and skills required in the future SCM workforce.

3. Methodology

As presented, the previous literature review emphasizes the importance of collaboration between industry and universities in identifying, assessing, and developing relevant SCM competencies in students. Regardless of the difficulty in identifying the key SCM competencies to be developed in a course based on industry requirements, extant literature shows some SCM competencies commonly identified as critical, presented here in Table 1.

Table 1. SCM competencies commonly identified as critical.

Competency	Description	Source
SC Diagnosis	the ability to define and understand supply chain complex problems	Birou *et al.*, 2022; Gámez-Pérez *et al*., 2020; Prajogo and Sohal, 2013; Dubey and Gunasekaran, 2015
Technology Adoption	the ability to be flexible and capable of adapting to new and changing situations, including the use of technology to support SCM operations	Al-Shammari, 2022; Fernando & Wulansari, 2021; Flöthmann *et al.*, 2018; Gámez-Pérez *et al.*, 2020
Data analysis and communication	the ability to understand the business context and effectively communicate findings	Al-Shammari, 2022; Birou *et al.*, 2022; Flöthmann *et al.*, 2018
Improvement proposals	the ability to solve complex problems, proposing improvements or innovations based on creating value for all the stakeholders	Prajogo and Sohal, 2013; Gámez-Pérez *et al.*, 2020; Flöthmann *et al.*, 2018

Source: Authors' compilation based on references.

Even though more competencies appear in the literature, the authors selected these four to be evaluated during their SCM course. A series of formative evaluations were conducted, which led to a summative assessment of each of the competencies, considering an intervention process from diagnosis to improvement proposals for the supply chain of the collaborating industry partners. In addressing the gap between academic training and industry requirements, the authors included experiential learning, role-play gaming activities, and industry-academia collaboration to enhance the development of the selected competencies.

Seeking to enhance the students' experiential learning, the authors implemented a project-oriented learning didactic strategy via the challenges posed by the collaborating organizations. Industry professionals were involved before the start of the semester in designing the challenge posed to the students and throughout it in assessing the presented proposals. In addition, intending to provide different points of view to analyze the problems and define feasible solutions, SCM experts from other industries and industrial chambers were invited to share their experiences and opinions on current disruptions and challenges.

Also, a LEGO supply chain scenario simulator was applied twice in the semester to enhance the students' learning experience, helping them to understand key SCM concepts, identify opportunities, and propose improvement actions. The first simulation was run at the beginning of the course to clarify SCM concepts and provide a systemic scope and a role-play gaming learning environment. The second one was run previously to elaborating the improvement proposals.

Being sensitive to the increasing interdisciplinarity of the SCM field in the constantly changing business environment, the authors considered that offering an integral approach from different disciplines will add value to the student's learning experience. Therefore, the professors implementing the course pertained to various fields -industrial engineering and international business- providing a multidisciplinary approach.

Concerning industry-academia collaboration, the organizations presented a specific problem that required using the selected competencies and assigned a mentor for each. Each mentor defined the number of follow-up meetings, whether in situ or virtual, the feedback procedure, and provided the information needed. In addition, sessions required by the professors in charge of tutoring the students complimented the students' learning experience. The chosen problems involved students analyzing and proposing improvements for previously defined supply chain operations. The industry partners were a Mexican-based organization in the meat industry during the Spring 2022 semester and a US-based organization in the heavy agricultural machinery industry during the Fall 2022 semester. Both organizations have worldwide operations and similar operative challenges. The results of the implementations are shown in the next section.

4. Results

The pilot implementation for the Spring 2022 semester was successful in that students, professors, and industry partners did perceive the development of the specified SCM competencies. Nevertheless, the professors and industry partners evaluating the student performance in such competencies detected room for refinement, particularly in the competence related to the improvement proposal. Even though the industry partner received the submitted proposals well, several issues were detected regarding the time scope limitation

confined to one semester, which limited the implementation and benefit measurement of the proposed improvement proposals.

Under such conditions, students cannot learn about the consequences of their decisions, and submissions remain at the proposal level. Therefore, the authors decided to implement The Fresh Connection™ (TFC) simulator during the Fall 2022 semester, in addition to the previously described conditions implemented during the Spring 2022 semester. The authors intended to overcome some of the mentioned shortcomings since TFC requires analysis and decision-making processes from participants, assuming the perspective of various roles. TFC simulates the students' decisions during six rounds in a SC scenario, each representing six months, allowing the participants to face the consequences of their improvement decisions and acknowledge their errors for three years. The following figure compares the average grades obtained by students on the individual submissions designed to demonstrate the development of the specified four SC competencies.

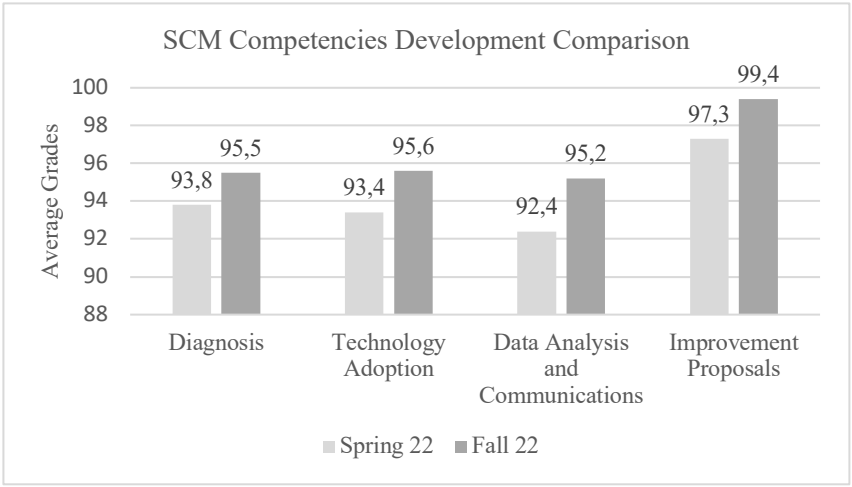

Figure 1. Average grading comparison of individual student deliverables on competencies development.

Even though the average grades increased during the Fall 2022 semester, the main concern was identifying the benefit of a physical role-playing simulation using LEGOs and the specialized SC software TFC to refine the students' deliverables. In this regard, a Student's t-test analysis was conducted to compare the grades of the student proposals presented during both implementations. The null hypothesis assuming group similarity was rejected, demonstrating a significant upgrade of the improvement proposal competency in students after experiencing TFC simulator in combination with various learning environments. The grading process includes the comments from the mentors and the professors' assessment of the competence based on a rubric. Results are shown in Table 2.

Table 2. T-Test two samples assuming equal variance.

	Spring 2022	*Fall 2022*
Mean	97.3529412	99.3333333
Variance	10.9625668	0.91954023
Observations	34	30
Pooled Variance	6.26502214	
Hypothesized Mean Difference	0	
df	62	
t Stat	-3.158639	
P(T<=t) one-tail	**0.00122485**	
t Critical one-tail	1.66980416	
P(T<=t) two-tail	**0.00244971**	
t Critical two-tail	1.99897152	

5. Discussion

A combination of learning didactic strategies, information technology aids, and dual learning during the implementation of a SCM course enhances the development of the professional competencies required to thrive in a changing business environment. However, there are limitations to developing SCM competencies in the classroom, even when innovative learning techniques are implemented, as was detailed in the literature review. The authors tested a combination of several learning environments and were able to compare the results from two consecutive implementations under similar conditions. There are limitations to the development of competencies in students confined to one semester in the classroom. Hence, it is necessary to provide experiential learning as close as possible to real-life challenges to overcome such shortcomings and strengthen the development of the nuch-sougth SCM competencies, which have become a competitive advantage for organizations. Although the inclusion of several learning environments, such as the physical LEGO simulator and the use of TFC created a positive benefit in terms of competency development, this was only possible in combination with the guidance and tutoring of professors, the interaction with industry experts, a multidisciplinary approach, and a hands-on experience.

6. Conclusion and Future Work

After two implementations of the course, the SCM competencies were developed satisfactorily, based on evaluations of the students' deliverables by the industrial partner and the team of professors. The multidisciplinary work, the simulators, the organizations' supply chain problems, and the evaluation from industry experts and professors allowed the students to experience similar real-life challenges. Finally, designing a SCM course is a dynamic, iterative process if it is to be aligned with the changing environment and disruptions faced

by supply chains nowadays. Hence, this course's didactic design and improvement processes must be continuously adapted to current and future disruptions influencing a supply chain, the industry's needs, and other collaboration schemes.

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