Enhancing International Supply Chain Teaching: Incorporating Sustainability, Basic Calculations, Scenario Planning, Lean Six Sigma, and Inchainge Simulations

Pedagogical paper

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This paper addresses the conundrum of modern supply chain education, challenged by a burgeoning knowledge base and the imperative of delivering education with efficacy and value. It identifies gaps in integrating the real challenge of sustainability, analytical skills, and practical experiences with a case study approach of tested solutions in an apprenticeship MSc level course context. This approach includes Inchainge simulations for hands-on learning, and project based Lean Six Sigma Certification, with Chatbot enhanced coaching. It points to aligning education with industry expectations through customized learning paths, aiming to develop professionals proficient in data-driven decision-making, team dynamics, and sustainability.

Keywords: word; education, efficacy, value, sustainability, apprenticeship, AI, chatbot, project based learning

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This paper addresses the conundrum of modern supply chain education, challenged by a burgeoning knowledge base and the imperative of delivering education with efficacy and value. It identifies gaps in integrating the real challenge of sustainability, analytical skills, and practical experiences with a case study approach of tested solutions in an apprenticeship MSc level course context. This approach includes Inchainge simulations for hands-on learning, and project based Lean Six Sigma Certification, with Chatbot enhanced coaching. It points to aligning education with industry expectations through customized learning paths, aiming to develop professionals proficient in data-driven decision-making, team dynamics, and sustainability.

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Introduction

Quotes:

Charles: "Dad, just tell me what supply chain I need to know to run my company"

James: "Dad, I have found this amazing piece of software. Ask me a really tough question and I will give you the right answer."

Anonymous: "What is the common factor amongst: politics chatgpt and education? Without, operationalization, there is no outcome."

A Triple Challenge (TC) in Supply Chain and Purchasing Education

If we pursue success in Supply Chain and purchasing education, we are really trying to solve a triple conundrum because we want to reconcile company's needs, which can be conflicted between satisfying their customers, maintaining profitability, doing the right thing by the environment and keeping their employees happy[1]. Then we have to contend with the student's ability and motivation to learn and to apply the concepts that we would like to teach them. And last but not least, we've got constraints around the courses that we give, in particular in terms of course length and development load. Teaching soft skills is not straight forward. We can even be challenged to find teachers that deliver the material in a compelling and attractive way! It looks as if education is faced by the same great divide as businesses with regard to mass-customization:
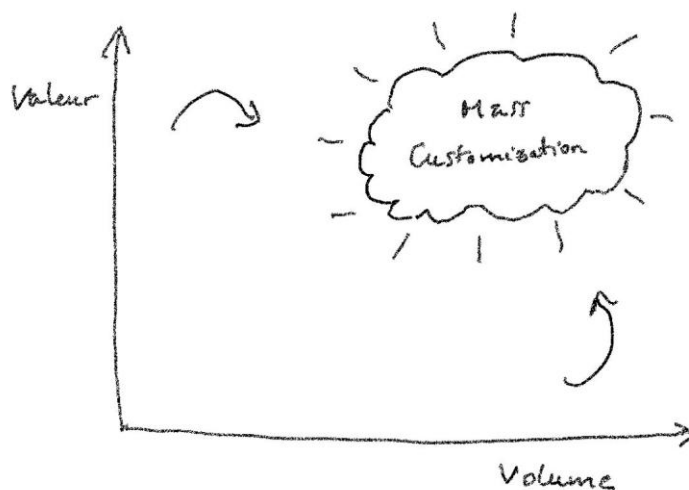

Figure 1 : mass customisation, Authors (2024)

Technology as a step to solving to the Triple Conundrum in Sustainable Supply Chain and Purchasing Management

The opening quotes are meaningful to authors because they highlight clues that can help us do our job as educators. "*When my son Charles asked me what was particularly*

relevant to the success of his company, I was able to give him an executive summary and point him in the right direction". Whenever students are enthusiastic and motivated, they are quite self-directed and autonomous and the focus of teaching moves from the base of Bloom's taxonomy to the top. The apprenticeship model was built around enabling the apprentice to deliver value and because the chatbot provides a 24/7 personal tutor and we have validation both on the academic and the company sides, it seems reasonable to embrace the technology[2,3,4,5] to optimize the outcome.

Oregon State University Ecampus

Bloom's Taxonomy Revisited

Use this table as a reference for evaluating and making changes to aligned course activities and assessments (or, where possible, learning outcomes) that account for generative Artificial Intelligence (AI) tool capabilities and distinctive human skills.

All course activities and assessments will benefit from **review** given the capabilities of AI tools; those at the **Remember** and **Analyze** levels may be more likely to need **amendment**.

	RECOMMENDATION	AI CAPABILITIES	DISTINCTIVE HUMAN SKILLS
CREATE	Review	Suggest a range of alternatives, enumerate potential drawbacks and advantages, describe successful real-world cases	Formulate original solutions incorporating human judgement, collaborate spontaneously
EVALUATE	Review	Identify pros and cons of various courses of action, develop rubrics	Engage in metacognitive reflection, holistically appraise ethical consequences of alternative courses of action
ANALYZE	Amend	Compare and contrast data, infer trends and themes, compute, predict	Critically think and reason within the cognitive and affective domains, interpret and relate to authentic problems, decisions, & choices
APPLY	Review	Make use of a process, model, or method to illustrate how to solve a quantitative inquiry	Operate, implement, conduct, execute, experiment, and test in the real world; apply creativity and imagination to idea & solution development
UNDERSTAND	Review	Describe a concept in different words, recognize a related example, translate	Contextualize answers within emotional, moral, or ethical considerations
REMEMBER	Amend	Recall factual information, list possible answers, define a term, construct a basic chronolgy	Recall information in situations where technology is not readily accessible

Table 1 : Advancing Meaningful Learning in the Age of AI – Artificial Intelligence Tools – Faculty Support | Oregon State Ecampus (2023)

Lean Six Sigma Principles as a step to solving to the Triple Conundrum in Sustainable Supply Chain and Purchasing Management

The convergence of Lean methodologies with sustainable supply chain practices presents an effective solution to the paradox of balancing return on investment (ROI) with sustainability. This approach, advocated by organizations like France Supply Chain[6] and the U.S. Environmental Protection Agency[7], leverages Lean's impressive track record in waste minimization. By removing waste, Lean directly benefits the environment, a key consideration for the EPA, while simultaneously enhancing customer focus and company profitability. Furthermore, Lean principles streamline employee tasks and processes, giving them a voice in the steering of operations. Applying these principles to the teaching process in supply chain management mirrors these benefits, fostering a culture of resource optimization that aligns profitability with sustainable practices. This strategic alignment not only streamlines operations but also addresses our triple conundrum: satisfying corporate needs, maintaining environmental integrity, and ensuring employee satisfaction. Lean, therefore, emerges as a holistic solution that optimizes outcomes both in business and educational contexts.

When we consider Lean Six Sigma, we're taking a step in another direction, because beyond the mundane definition of reducing variation, Six Sigma allows us to aim not only to do things right, but to do the right things and the DMAIC (Define-Mesure-Analyze-Improve-Control) framework is a high performing project-based model, that connects with AI assisted "Project based learning"[5] and reconnects lean to Quality Assurance as well as Manufacturing Planning and Control.

Case study: the use of business games as a step to solving the Triple Conundrum in Sustainable Supply Chain and Purchasing Management

Positioning the case in relation to the academic literature

Although there has been criticism[18,26], the prevailing belief in higher education research and practice is that today's students are influential "digital natives"[29] (. An examination of the literature reveals that there are eight controversial claims about digital natives in higher education. These claims suggest that students of the Internet generation possess new ways of knowing and being, are leading a digital revolution that is transforming society, are inherently skilled with technology, are capable of multitasking, are team-oriented and collaborative, are native speakers of the language of technology, embrace play, interaction, and simulation, demand immediate gratification, and reflect and respond to the knowledge economy.

Despite data that contradicts these ideas[20,26], they nonetheless have a significant impact. Uncertainties persist regarding the process of restructuring and reevaluating novel classifications or frameworks pertaining to pupils' utilization, principles, and requirements of technology[18]. Additional research is required to gain a genuine comprehension of the range of students and their viewpoints on new technologies in various educational settings[34]. To enhance our understanding of technology difficulties in higher education, it is important to develop and employ comprehensive and sophisticated alternative classifications and theoretical frameworks, instead of unquestioningly adopting prevailing beliefs about digital natives.

Nevertheless, students belonging to Generation Z possess distinct anticipations regarding pedagogical methodologies. Their preference lies in collaborative learning approaches that prioritize group collaboration among students from diverse backgrounds[32]. Generation Z students exhibit a strong inclination towards video-based

learning and demonstrate a preference for obtaining, disseminating, and validating knowledge through many channels, including social networks and video platforms[24]. According to Bora and Görsev[19], students anticipate that teachers and learning resources will be focused on technology and tailored to their individual and educational requirements. Generation Z students in technological and scientific sectors anticipate an education that incorporates digital technologies and encourages participation through social networks[27,21,25]. Generation Z students have a general expectation for educational methods to be participatory, technology-driven, and customized to their specific needs and interests.

Case Studies Overview:

The case study covers two distinct student populations, presented in Table 1.

	PPA business School	ESCP Business School
Format	Part-time training	Classic
Access	Post-bac	Preparatory classes
Year	M2	M2
Specialty	Supply chain	Supply Chain
Course	Inchainge Business Simulation Suite Utilization Lean Six Sigma Project based Certification Process Order Point Planning Development	Blockchain Course Implementation
Ranking	Not ranked in « grande école de commerce en France »	Second in « Grande école de commerce en France »

Table 1 : case study description

We present the detailed programs of the courses.

Blockchain Course Implementation (Skema Lille and ESCP): Examined the use of AI, particularly ChatGPT[15], to simplify complex blockchain concepts, resulting in reduced slide content, incorporating assessments around case study presentations, open book exams and practical game based programming courses.

Inchainge Business Simulation Suite Utilization: Focused on the integration of Blue Connection and Triple Connection simulations into the curriculum, with limited instructor availability leading to a flipped classroom approach and peer-to-peer learning.

Lean Six Sigma Project based Certification Process: Explored integrating Lean Six Sigma into supply chain and purchasing courses, utilizing eLearning tools such as the Jack Welch Institute's LinkedIn learning[16], formative assessment with quizzes and evaluated student "teachbacks" and incorporating a novel coaching component supported by chatbots.

Order Point Planning Development: Built upon HEC's pedagogy[8], tying together replenishment model and manufacturing planning control from the CPIM Part One course of ASCM[17], and tested students on devising a replenishment processes for a new product scenario.

Organization

If French[8] and US[9] supply chain education have finally agreed on the value of teaching both Lean and Theory of Constraints, it is really France that has grappled with the numbers side of decoupling points, inventory and work in process leading to the current supply chain business game Réaktik (www.cipe.fr) that has survived the test of time.

Moreover, it is when we organize a business game in class with our students that we are able to grapple with the soft skills that are otherwise a little hard to teach[1].

The Inchainge company (www.inchainge.com) has a Monte Carlo dynamic simulation offering adopted by universities as well as companies worldwide that cover a wide range of Supply Chain and Purchasing topics:

Understand the End-to-End Supply Chain
Supply Chain Fundamentals
End-to-End Supply Chain Management
Supply Chain Segmentation
Supply Chain and Market Expansion
Working Capital Management
Supply Chain Finance

Experience S&OP and IBP
Sales and Operations Planning
S&OP and Multichannel SCM
Integrated Business Planning

Manage Supply Chain Disruptions
Supply Chain Resilience
Supply Chain Risk Management
Supply Chain Finance

Create a Sustainable Business
Carbon Footprint Optimization
Sustainable Business
Circular Business Transition

Develop Data Literacy
Data Analytics in Supply Chains

Figure 2 – Inchainge (2024)

This course span is shouldered by 4 generic business games:

Business Games

The Fresh Connection
THE ULTIMATE VALUE CHAIN EXPERIENCE
Discover The Fresh Connection

The Triple Connection
Discover The Triple Connection

The Cool Connection
BRIDGING PHYSICAL AND FINANCIAL SUPPLY CHAINS
Discover The Cool Connection

The Blue Connection
EXPERIENCE A CIRCULAR FUTURE
Discover The Blue Connection

Figure 3 – Inchainge (2024)

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[1] Difficult not to like Stanford GSB offshoot responsive.net/ Learning technologies "Littlefield", that introduces students to the chaos of managing a job shop environment at high flow.

All of these satisfy the requirements of complexity whilst being based on relatively simple business models. A common thread throughout is developing the ability to assess the process so as to parse through large amounts of data to separate the vital few from the trivial many and to make the connection between operational data and financial account analysis.
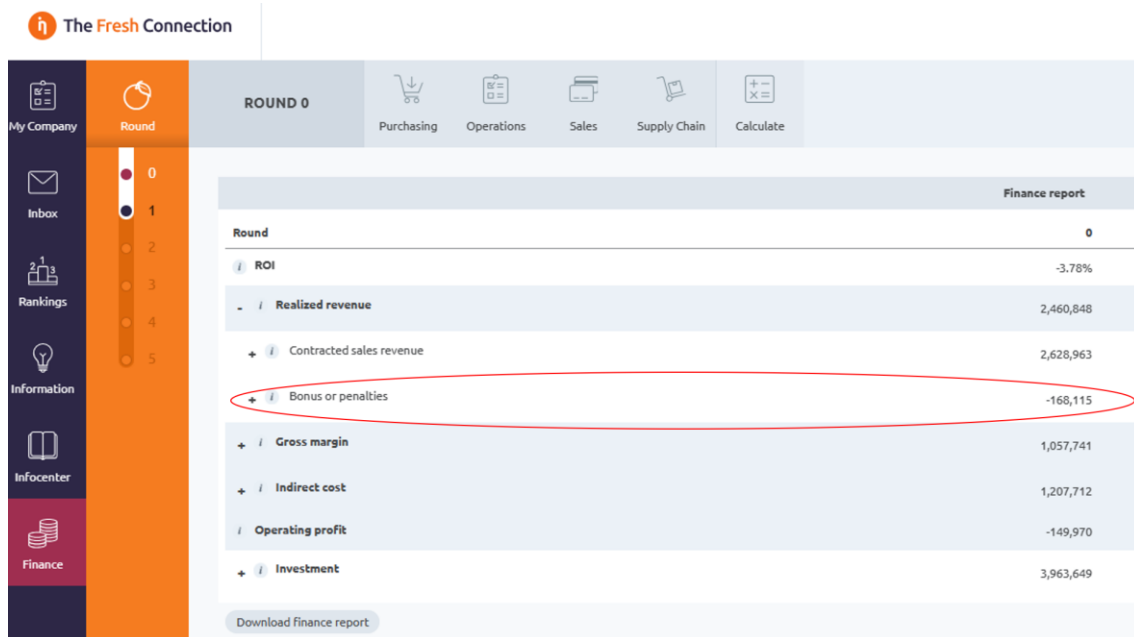

Figure 4 – Inchainge (2024)

As part of the assessment, we systematically include a process mapping or a cause-effect mapping exercise. For the Fresh Connection, the latter might look like this:
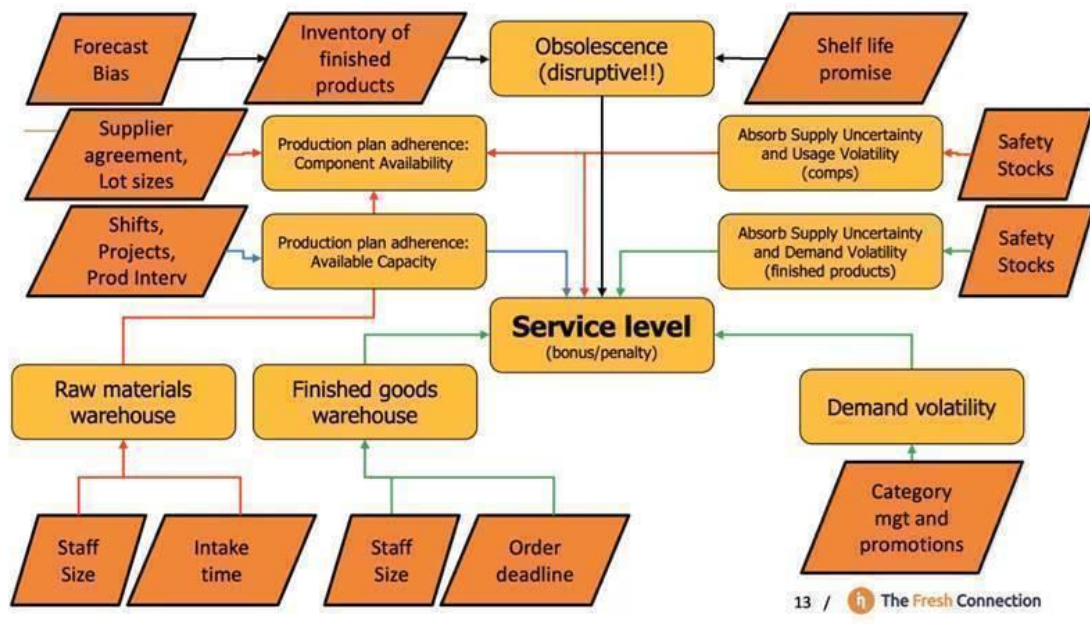

Figure 5 – Inchainge (2024)

The Crucial Balance of Narrative and Numbers[1,10]:

Ultimately, the success of a business model in this context is contingent upon satisfying both the narrative and numbers test. The narrative test assesses the coherence of a company's strategy with its commitment to sustainability, ensuring that the story behind its operations resonates with ecological and social responsibility. Concurrently, the numbers test scrutinizes the financial viability of these strategies. A company's Profit and Loss (P&L) statement becomes a critical litmus test, reflecting the practicality and effectiveness of integrating sustainable practices. Both the Cool Connection and the Blue Connection go a step further by opening up the company balance sheet to assist the analysis. Remarkably, in the case of Cool connection IBP and to the student's delight,

the stock market particularly rewards the ability of the student teams that are able to balance the optimisation of the Supply Chains profit and staying on plan for budget!

With regard to Blue Connection, the software rewards teams that successfully provision the capacity load constraint and punishes teams that are not consistent with their strategy: it is easy to achieve high circularity and avoid profit!
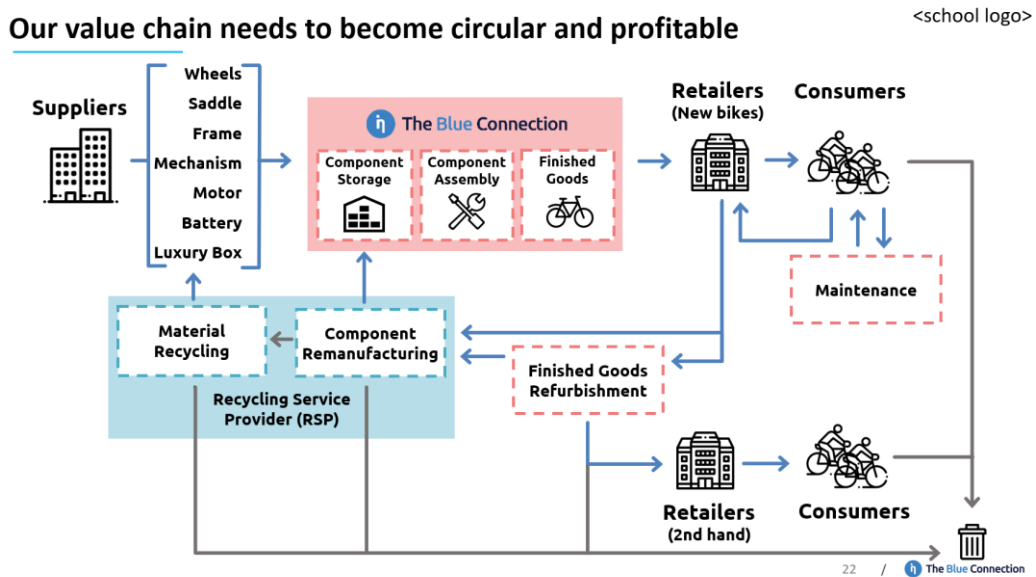

Figure 6 – Inchainge (2024)

The Triple Connection: a triple roadmap to success in sustainability.

Current legislation requires companies to take responsibility for their upstream supply chains, and beyond the first response of "not my problem" ". The Triple Connection takes a well-documented case of world trade inequity[11] and establishes a win-win paradigm, not dissimilar to McDonald in its Indian operations[12].

Also, whereas sustainability squarely challenges the simple maximization of return on investment, the Triple connection uses the "True Cost" model to distill relevant costs from the UN's Sustainable Development Goals to define a quadrant of "Sustainability advantage" that recalls Porter's "Creating Shared Value"[13].
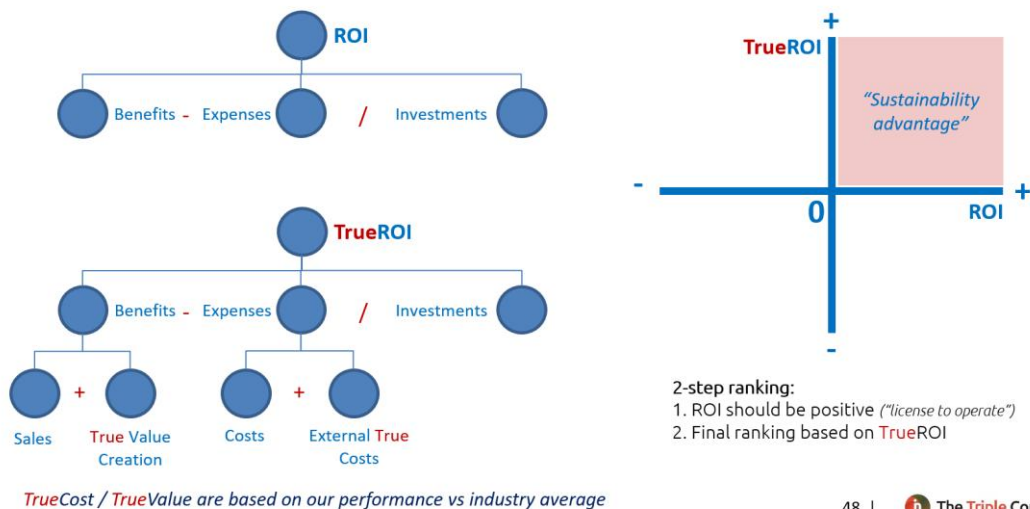
Figure 7 – Inchainge (2024)

Playing the game is fascinating because the win-win hinges on the successful interplay between careful operation management and wise spending of the development budget.

If we will continue to wait generalization of true cost accounting advocated by the IFRS and the ISSB[14], the Triple Connection lastly offers us a double possibility:

- Benchmarking a company's practices so as to distill avenues to being better than average.

- To re-establish the value of continuous improvement and to strive to reconcile operations with long term profitability.

Results

We present the results obtained in the four provided courses.

Blockchain Course

The course has adeptly achieved a diminution in complexity without compromising the concentration on business applications of blockchain technology. This has been accomplished without sacrificing the depth or integrity of the subject matter, ensuring that learners are still provided with a robust understanding of blockchain's commercial implications.

Furthermore, there has been a judicious implementation of artificial intelligence tools to elucidate foundational blockchain terminology and to meticulously organize the course syllabus. This utilization of advanced technology has enhanced the pedagogical framework, thereby facilitating a more accessible and coherent educational experience for participants.

Inchainge Business Simulation
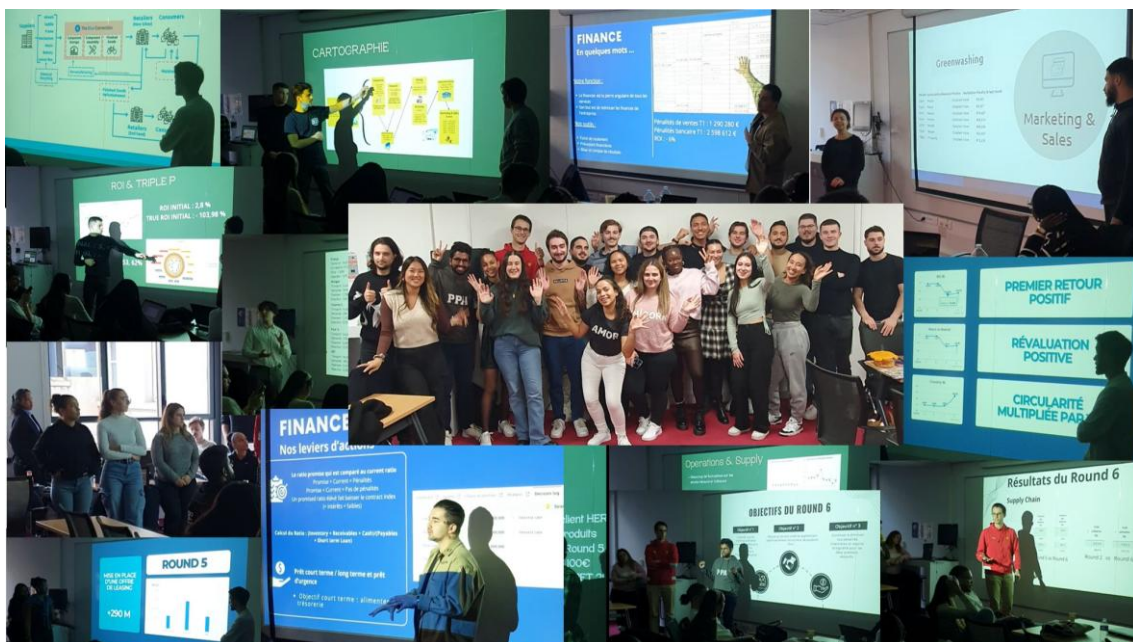
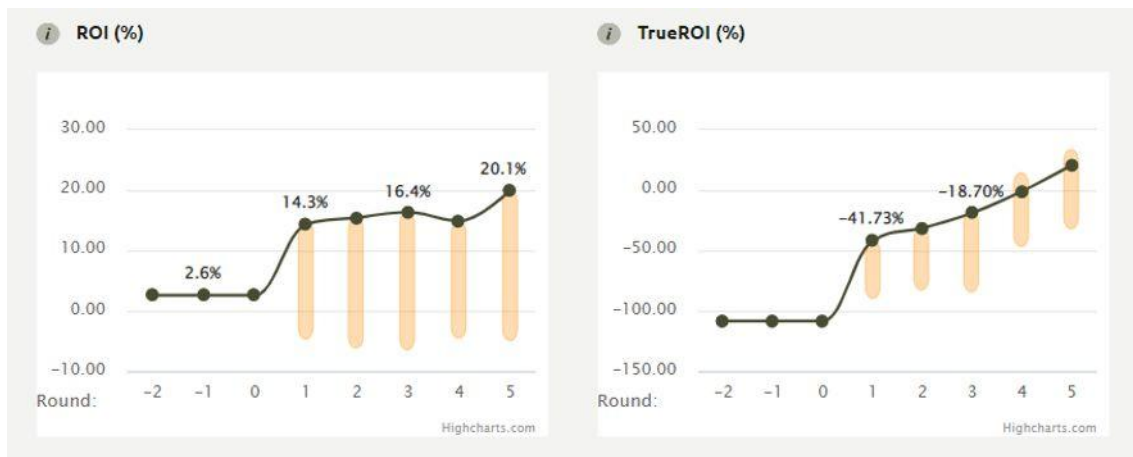Pictures : authors with students agreement (2023)

Figure 8: authors (2023)

The research has empirically demonstrated the feasibility of a supply chain paradigm that is both fiscally profitable and environmentally sustainable. Through rigorous quantitative analysis, the development of such a supply chain has been grounded in statistical evidence, showcasing its potential viability in the contemporary marketplace.

A novel pedagogical approach has been developed which fosters peer-to-peer learning and the enhancement of presentation acumen. This model restructures traditional didactic methodologies to incorporate collaborative learning experiences, thereby enriching the educational process and equipping learners with vital communicative competencies.

Furthermore, the observation of student engagement and assimilation of knowledge has been conducted through the implementation of simulations. These practical exercises provide an immersive learning environment, allowing for the observation of students' interactive participation and the real-time application of theoretical concepts, thereby offering tangible insights into the educational impact of the simulated activities.

Lean Six Sigma Certification:

The electronic learning modules and webinar content have been met with favorable reception, indicating a successful alignment with the educational preferences and requirements of the target audience. The digital format of the course material has evidently resonated with learners, suggesting that the eLearning strategy effectively disseminates the intended knowledge.

Student comprehension has been notably enhanced through a series of verifications and an interactive coaching methodology, supplemented by chatbot assistance. This integration of technology facilitates immediate feedback and personalized guidance, resulting in a more engaging and supportive learning environment that caters to individual learner needs.

Research has underscored the significance of experiential learning within the workplace for the attainment of Lean Six Sigma certification. Practical application of Lean Six Sigma principles in a real-world context has been identified as a critical component of the learning process, reinforcing theoretical knowledge and contributing to the development of competencies essential for certification.

Order Point Planning:

The integration of pedagogical approaches ASCM[17] and HEC[8] has been strategically employed to address and reconcile the challenges inherent in inventory management and manufacturing planning and control. This educational synthesis has been designed to provide a comprehensive framework that enables learners to navigate the complexities of aligning these critical supply chain components.

Students have been successfully evaluated through their engagement with realistic supply chain scenarios, which include the management of a product launch

accompanied by both optimistic and pessimistic forecasts. This testing methodology ensures that learners are not only exposed to theoretical models but are also compelled to apply their knowledge to dynamic and variable real-world situations, thereby assessing their practical understanding and decision-making skills within a supply chain context.

Lancement de nouveau produit PFA: le point de Commande permet de réconcilier la prévision optimiste et la prévision pessimiste.

Prévision demande palettes/mois:
Cas optimiste: $y = x + 2x^2$
Cas Pessimiste: $y = x + x^2$
Taille de lot unitaire = 33 palettes
(camion complet, stock initial)

PFA (2j)

111 (5j)   112A (10j)

222 (3j)   244A (8j)

331A (10j)
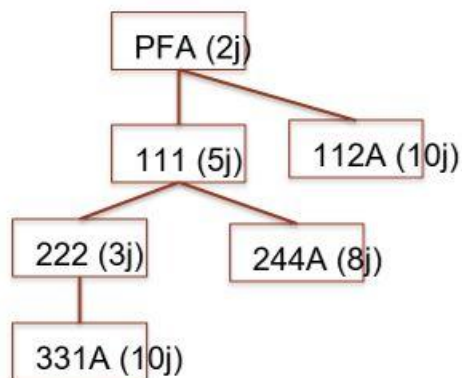
Comment batir le système de recomplètement?

Figure 9 – authors (2023)

Discussion

The incorporation of artificial intelligence and ChatGPT within the blockchain course curriculum has been efficacious in amalgamating students' requisites for comprehensive detail with their emphasis on business applications. This integration has significantly augmented student comprehension and engagement, denoting a successful pedagogical strategy in teaching complex technological concepts.

The adoption of a flipped classroom pedagogy in the context of business simulations and Lean Six Sigma coursework has fostered an environment conducive to active learning and peer-to-peer instruction. This approach intimates the potential for a diminished reliance on traditional instructor-led frameworks, suggesting a paradigm shift towards more student-centric learning models.

The amalgamation of Lean Six Sigma principles with eLearning components and chatbot-assisted coaching has effectively bridged the gap between the theoretical constructs and their practical applications. This blend of instructional modalities illustrates the efficacy of blended learning environments, which cater to diverse educational needs and learning styles.

Furthermore, the development of the Order Point Planning module has underscored the merit in juxtaposing various pedagogical techniques to furnish a holistic educational experience in supply chain management. This approach has highlighted the importance of integrating different instructional methods to deliver a comprehensive and multifaceted understanding of supply chain dynamics.

Conclusion

The case studies demonstrate innovative approaches to enhancing the teaching process in supply chain and purchasing education at the MSc level. The integration of AI and digital tools, such as ChatGPT, in course preparation and delivery, along with practical, hands-on learning methods, like simulations and real-world case studies, significantly contributed to the effectiveness of the educational process. These methods successfully addressed the challenges of delivering complex, relevant content while fostering student engagement and skill application. The findings from these case studies offer valuable insights for educators seeking to optimize teaching methodologies in the evolving field of supply chain and purchasing management.

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