New Orleans JAZZED about Engineering Education

Paper ID #16883

How to Effectively Teach an Online Graduate Operations Management Course?

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Abstract

This paper introduces practices in teaching an online graduate Operations Management course. A combination of instructional approaches including active learning, cooperative learning and problem-based learning were applied in teaching through threaded discussions, Blackboard Collaborate sessions and project etc. In addition, students developed simulation games in their group project to simulate business operations and dynamics. The design of the games not only helped students quickly gain a conceptual background of the real world operations problems, but also increased the depth of their learning. A rich combination of project work and exposure to engineering practice throughout the curriculum provided excellent vehicles for students to develop their critical thinking and problem-solving skills.

Introduction

Operations management refers to the systematic design, direction, and control of processes that transform inputs into services and product for internal, as well as external customers. It is a vital topic that every engineering management student needs to understand because it is at the heart of the creation of wealth for business and the improvement in the living standard of citizens of all countries[1]. Operations Management has been listed as a core course in the management science and engineering programs all around the world[3]. This course usually covers broad areas such as process analysis, quality and performance, capacity planning, supply chain, inventory management, forecasting, operations planning and scheduling, and resource planning etc., which are all closely related with the daily operations of enterprises. However, due to lack of experiences in business operations, most of the students feel the course difficult to learn. The traditional teacher-oriented teaching method, in which the teacher explains the textbook contents to students, makes students lose interests and confidence. An online Operations Management course in which the students and instructor have limited/no face-to-face communications is even more challenging.

How to stimulate students' enthusiasm and critical thinking, and increase students' engagement in and out of classroom is crucial for effective teaching of this subject, thus should be highly valued. The initial purely theory-oriented mode has been gradually adjusted to active learning (getting students to do things in class that actively engage them with the material being taught), cooperative learning (putting students to work in teams under conditions that promote the development of teamwork skills while assuring individual accountability for the entire

assignment), and problem/task-based learning (teaching material only after a need to know it has been established in the context of a complex question or problem, which increases the likelihood that the students will absorb and retain it)[7], thereby improving students' learning initiative to a certain extent[2,3].

This paper discusses how to effectively teach an online graduate Operations Management course. A combination of teaching approaches that the author adopted in the recent offering of Engineering Management course is introduced. In that class, active learning, cooperative learning and problem-based learning were applied through case studies, threaded discussions, Blackboard Collaborate sessions and project etc. In addition, students were asked to develop their own simulation games in their group project to simulate business operations and dynamics. The use of games in teaching is not foreign. Simulation games such as beer game, dice game etc. have been used to teach Operations Management, where games were used primarily to motivate students by introducing an interesting topic or series of assignments. For instance, the beer game, invented in the 1960s by Jay Forrester at MIT, is a role-play simulation game that lets students experience typical coordination problems of supply chains, in which information sharing and collaboration does not exist. The beer game was used to demonstrate the benefits of information sharing, supply chain management, and eCollaboration in the supply chain. Our research went one step further. Students created entirely new games to enhance their learning of operations management fundamentals. The depth of learning increased as the students designed and built the games, instead of just playing them. Well developed games allowed students, who may lack work experience in operations, quickly gained insights into real-world operations management problems.

The students' feedback and the end-of-course survey were collected at the end of the course, which demonstrated that these teaching methodologies especially the simulation game project stimulated students' enthusiasm and critical thinking, improved students' problem-solving skills, thus ensured that students were better prepared for future engineering practice.

Course Description and Learning Outcomes

The course ENM603 Operations Management is a subject course in the Master of Science in Engineering Management program at National University. It introduces the principles and techniques for designing, analyzing, and managing operations processes. It addresses how all operations and behavior components fit together and how to identify and resolve the right problem. This course covers broad areas such as process analysis, quality and performance, capacity planning, supply chain, inventory management, forecasting, operations planning and scheduling, and resource planning etc., which are all closely related with the daily operations of enterprises.

The Course Learning Objectives (CLOs) are as follows:

- Describe operations management and how it applies to project management engineering.
- Analyze the role of behavior and communication in operations management.
- Apply problem identification and problem-solving processes.
- Determine the appropriate operations management tool(s) to be used during the problem-solving process.
- Design and develop a process including comparison of methodologies to maintain and manage a process.
- Determine the appropriate operations management concepts and tool(s) to be addressed during the design development and management of a process.
- Evaluate the application of current and future technologies to operations management.
- Integrate total quality into operations management.
- Apply project management engineering techniques in operations management.
- Summarize operations management concepts, culminating in an operations improvement plan.

All of the CLOs are assessed using different course activities such as homework assignments, threaded discussions, quizzes, the final exam and a project.

Accelerated Course Format

Founded in 1971, National University is the second-largest private, nonprofit institution of higher education in the state of California. For more than forty years, it has been dedicated to making lifelong learning opportunities accessible, challenging, and relevant to a diverse student population. National University provides challenging and relevant programs that are student-centered, success-oriented, and have a proven balance of theoretical and practical attributes. A leader in online education, National University offers more than 70 graduate and undergraduate degree programs and over 1,200 courses online. These programs and courses are delivered using the up to date technology to provide dynamic, interactive learning environments, online, 24 hours a day, seven days a week. The unique one-course-per-month format (students only take one course each month and complete it in four weeks) gives students unprecedented focus and flexibility, and lets the students earn their degree on their own schedule. But on the other hand, this accelerated course format, where the students need to complete one course in four weeks, make the courses especially challenging to students.

Under the one-course-per-month framework, the Operations Management course contents were divided into four major topics, each for one week as shown in Table 1. Each week's lesson will consist of reading from the text, online Blackboard Collaborate sessions, question and answer via discussion board, homework assignments, quizzes/exam and a simulation game design project.

Table 1: Course Topics and Class Activities

Date	Topics	Class Activities
Week 1	Planning Operations: - Using Operations to Compete - Decision Making - Forecasting	- Assignment #1 - Threaded discussions - Online BB Collaborate session - Quiz #1 - Game design project idea
Week 2	Operations Design and Analysis: - Process Strategy - Process Analysis - Supply Chain Integration	- Assignment #2 - Threaded Discussions - Online BB Collaborate session - Quiz #2 - Development of the game
Week 3	Optimizing Operations: - Quality and performance - Capacity Planning - Waiting Lines - Operations Planning and Scheduling	- Assignment #3 - Threaded discussions - Online BB Collaborate session - Quiz #3 - Project report draft
Week 4	Manufacturing Operations: - Supply Chain Inventory Management - Recourse Planning - Lean Systems	- Assignment #4 - Threaded discussions - Online BB Collaborate session - Final exam - Final project report and presentation

Threaded Discussions

The online threaded discussion provides students an opportunity to participate in virtual conversations at any time and any location. It can help students synthesize knowledge into understanding of the weekly course learning objectives. Evidence showed threaded discussions increased the amount of time students spent on class objectives comparing to face-to-face discussion as in an onsite class. And the students appreciated the extra time for reflection on course issues[4]. It was also reported that online threaded discussion can improve critical thinking[5]. A study at Athabasca University [6] found online students "experienced greater cognitive and explanatory learning" as a result of greater participation in course communications where students exchanged "between 80 and 100 messages, which is far richer than the classroom."

In the Operations Management course, each week several real-world open-ended questions, shown as below, were assigned in the Discussion Board for students to answer.

- Consider Amazon.com, whose web site enjoys millions of "hits" each day and puts customers in touch with millions of services and products. What are Amazon's competitive priorities and what should its operations strategy focus on?

- What do you think is a good *service package* of a grocery store like Von's, Albertson's, or Ralph's? What do you think are some of the issues in adding a new service, like home delivery, to their service package?
- How do the process strategies of eBay and McDonald's differ, and how do their choices relate to customer-introduced variability?
- Firms such as Wal-Mart, General Electric, Chase Manhattan, and Boeing have a lot of influence in their respective supply chains because of the power they have. Explain how firms with a lot of power can influence supply chain integration.
- Hospitals and manufacturing companies both are concerned with quality and utilize TQM programs. Discuss the similarities and differences between these organizations and how they provide quality and utilize TQM.
- Some employers maintain stable workforces at all costs, while others layoff and recall workers seemingly at the drop of a hat. Discuss what you think are the differences in markets, management, products, financial position, skills, costs, and competition that could explain these two extreme personnel policies.

Students need to respond to these instructor's questions and other students' postings. Students were asked to be creative, and synthesize, enlighten, inspire and add insight to the discussion. Instead of a discussion being limited to the time set aside for the face-to-face class, these online threaded discussions occurred over a week. “It takes a lot of time” was not an uncommon comment from students. Almost every student spent substantial time to read others’ postings, think about a response, prepare a response, and check back later to see others’ contributions to the discussion. Exploring these questions, students identified what they already knew, what they needed to know, and how and where to access new information that may lead to the resolution of these problems.

The threaded discussions were graded based on Quality of Information and Delivery of Information in this Operations Management course using the predefined rubric.

Blackboard Collaborate Sessions

The Blackboard Collaborate session is a great tool to create a student-centered learning environment online. Students and instructor can engage and interact as if there were in a traditional classroom with two-way audio, interactive whiteboard, application and desktop sharing , session recording etc. In the Operations Management course, two Blackboard Collaborate Sessions were scheduled every week, each for two hours**.** Unlike traditional lectures, in which the instructor is the only one who is active and students are just watching , listening and taking notes[7], the students were asked to work individual or in groups on brainstorming, problems solving and case studies. At the end of the allotted time, the instructor called on individuals or teams for their responses and/or solutions. The goals of these sessions were to help students develop flexible knowledge, effective problem solving skills, self-directed learning,

effective collaboration skills and intrinsic motivation. The role of the instructor was to facilitate learning by supporting, guiding, and monitoring the learning process.

The sessions were recorded which gives flexibility to students who could not attend an online session. If the student had to miss an online session, he/she could review the recorded session and submit a 1-2 page summary to the instructor to get credit for the session.

Game Design Project

Simulation games such as beer game, dice game etc. have been used to teach Operations Management. Using games, not necessarily video games, for instruction is one way to shift to a more appropriate education format for the Digital Generation. Make education more fun, students will be more inspired. Well developed games allow students, who may lack work experience, quickly gain insights into real-world problems. It has been shown[7] the depth of learning was increased as the students designed and built their own games, instead of just playing them.

The game design project was first introduced to online Operations Management class in October, 2015. The students were asked to develop an educational game dealing with key concepts in operations management using the problems given in textbook or other real-world problems. The prime objective of this game design project is to prepare the students to become systems thinkers, i.e., develop the ability to comprehend, model and analyze complex system behaviors and interpret results for effective decision making. Students were allowed to use any tools that they are familiar with (Excel, PPT, ProModel, Scratch or others) to develop game engine and illustrate operations management concepts, and were encouraged to add creative fun into the game.

In order to let student acquire applicable game design knowledge in the shortest amount of time, the instructor demonstrated an example game developed using Microsoft PowerPoint (PPT) and Excel in the first week of the class. PPT has the capability of designing simple objects and integration of graphics into a single interface while requiring little time to learn how to use for non-graphic design students, therefore it is ideal to build the game boards. The PPT component also allows the students to create individual game assets or characters for moving and playing in the game board. Excel can be utilized as the game engine which refers to a software framework designed for the creation and development of games. Its calculation and graphing capability makes Excel a great tool to serve as the backbone of the games. Players could input player data, generate random numbers, maintain persistent variables, analyze data, program the simulated operation management systems, and receive output and status from the student developed Excel functions. More specifically, the game inputs come from the operation management simulation blocks created using Excel; the game then responds to the inputs, and based on the game interaction, the players make decisions and execute the game strategy. The

data generated by the game is fed back as input to the simulation blocks. The cycle repeats till the time limit is reached or certain constraints are met. The game procedure cycle is showed in Figure 1.

Figure 1: Basic Radio Simulation Game Procedure Cycle

The game development was divided into four stages. In the first stage, the students formed teams and chose their project subjects; in the second stage, each team designed game characters, objects, procedures, rules and game flow; the simulation blocks were developed in the third stage; and interaction and interfacing between game and the simulation blocks completed in the fourth stage. At the end of each stage the student teams presented and demonstrated their progress, and modified their project according to the instructors' and other students' comments and suggestions. The grade of the project was given based on the evaluation of a written report and the final presentation in the following dimensions:

- Description of Play
- Character and Game Object Description
- Game Challenges and Objectives
- Operations Management Concepts and Implementation
- Procedure/Rule Design
- Delivery & style
- APA format.

Three student teams were formed to do this course project. Each developed a different type of game. The team named "Cappuccino" developed a "Coffee Empire Game" which is similar to the Global Domination Game "Risk". The Coffee Empire game can provide students with a fun way

to learn operations management concepts related to quality of service. The game is played by two players – one who owns a Starbucks store and the second player owns a Coffee Bean store. The scenario of the game is based on a competition between Starbucks and Coffee Bean to take over the United States market. Business is going great for both owners. Both are looking to expand their operations beyond their home states and across the United States. The end goal is one owner will conquer all café territories throughout the United States to dominate the Coffee Empire. Players need to use forecasting tools to determine if entry into a certain state may be beneficial or detrimental to the company. In the case of determining which state to take over, a preference matrix was used to rate the alternatives based on several performance parameters. The game board as shown in Figure 2 was developed by using PPT, and Excel was used to do the forecasting and calculate the defined Quality of Service Index. The learning objectives of the game include resource management, quality management, and managing operations by expanding locations and competing for customers.

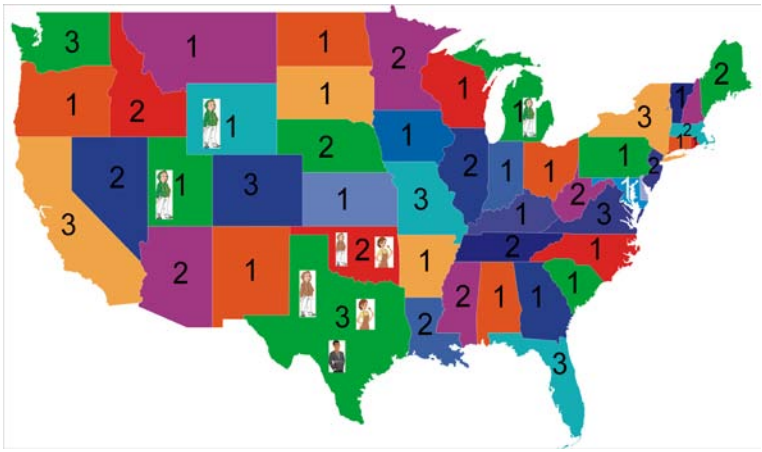

Figure 2: Coffee Empire Game Board

Another group developed "Operations Management Jeopardy Game", which allowed for a direct connection between the games and the desired learning outcome. The Jeopardy game's worldwide recognition makes it a powerful learning tool. Questions and answers in different categories and at a hierarchy of difficulty were developed by the students, formed in a manner in which to challenge the players critical thinking skills. The round ends when either the timer runs out or the players have answered the 30 questions. Each player only has a 15 seconds of time to answer the question. The one who accumulates the most money in three rounds ends up the winner. This game provided a highly engaging experience which lead to a deeper and fuller understanding of the operations management content being introduced.

Making learning fun encouraged students and helped them pay attention and stay attentive on the subject. One of the immediate observations was the level of concentration and collaboration

exhibited by the student teams. The instructor was surprised at the intensity and enthusiasm with which the students worked and progressed through course project in the team environment. The level of dedication and engagement was expressed through an apparent desire to learn the course contents in order to accurately incorporate the combination of operations management principles into the game simulation. This game design project changed student focus from learning of theory to practical application of the theory. The introduction of constructive competition provided an additional element of motivation, as it enhanced realism and amplified student ideas. Student deliverables and assignment scores revealed many significant and successful outcomes in this preliminary study. Some of the most interesting observations, based on student grading revealed the apparent increase in depth of learning and a unique knowledge transfer associated with the game design methodology, demonstrated in explanation and actual game play by each student.

Students Feedback

The teaching methodologies received very positive feedback from students. Most of the students strongly agreed in their course evaluations that

- I gained significant knowledge about this subject.
- My ability to think critically about topics in this class has improved.
- My ability to do research has improved.
- Discussions contributed to my learning.
- The required speaking assignment(s) improved my oral communication skills.
- I can apply what I learned in this course to my job or career goals.

The end-of-course survey in Table 2 reveals the students' opinions on the game design project. Most students agreed that the project made them take a more active part in the learning process. Although challenging, the project helped them analyze the basic elements of the course concepts, allowed for a deeper understanding of the course concepts, and led to more discussion of course ideas in and out of the classroom.

Table 2: End-of-Course Survey

No	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
1	The game design project helped me analyze the basic elements of the course concepts.	1			3	2	
2	The game design project allowed for a deeper understanding of course concepts.	1			2	3	
3	The game design project allowed for more discussions of course ideas in and out of the classroom.	1			3	2	
4	I took a more active part in the	1			3	2	

	learning process that was associated with the game design project.						
5	I found the use of the game design project challenging in the class.	1				5	

The limited number of students participating in the overall study, prohibited the collection of concrete quantitative results. However, this study's purpose and execution yielded significant results in terms of successful proof of concept, coupled with meaningful qualitative data allowing for further process improvements and act as a starting point for additional study.

Conclusion

As to the teaching effect, purely theoretical teaching cannot stimulate students' interest in learning, and there will not be a positive interaction between teaching and learning. This paper shows utilizing active learning, cooperative learning and problem-based learning approaches in threaded discussion and Blackboard Collaborate sessions, together with the game design project greatly enhanced the online teaching and learning experiences. The instructor's observations and the comments from the students demonstrated an apparent increase in engagement, depth of learning, and practical experience with course content and concepts. Students genuinely appeared to demonstrate greater practical knowledge of course topics and were consistently impressed with the level of discussion between student teammates, as well as level of complexity with questions being asked of them in regards to operations management theory and application. Students clearly demonstrated increased enthusiasm toward the subject matter and increased desire to collaborate in student teams, in order to see the fruition of their proposed games.

The teaching methodologies and game design project will continue to be used in the future offerings of the Operations Management course and other online courses that the author is going to teach. As more students participate, more data will be collected and quantitative analysis will be conducted to show the effectiveness of the proposed methods.

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