A CONCEPTUAL FRAMEWORK FOR EFFICIENT DESIGN OF AN ONLINE OPERATIONS MANAGEMENT COURSE

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ABSTRACT

This paper presents a framework for an efficient design of an undergraduate Operations Management online course based on Gagné's Nine Events of Instruction. It demonstrates how to design an undergraduate Operations Management course effectively so that each of the nine events occurs. It also evaluates the resulting course using Quality Matters standards. The paper concludes by providing tips and lessons learned based on feedback from students and course designers over multiple iterations of course offerings.

Keywords: Course Design, Operations Management, Gagné's Nine Events of Instruction, Quality Matters

INTRODUCTION

The emergence of online education poses challenges for higher education institutions. To remain competitive, universities must adapt the way education is delivered and develop curricula that meet the core competencies required in the market place (Christensen & Eyring, 2011). At a time when resources for education are becoming increasingly scarce, expectations for institutional accountability and student performance are becoming more demanding. There is a need for educational innovations that have a significant impact on student learning and performance (Jamieson & Lohmann, 2012).

The demand for online courses has increased dramatically within the last decade. According to a study by Allen and Seaman (2014), 7.1 million students took at least one online course in 2012, and the ratio of online to traditional courses is expected to continue to rise. To meet the demand for online delivery, it is common for face-to-face (FTF) courses to be redesigned into hybrid or online courses. To be efficient yet effective in meeting the learners' needs, the course should be redesigned in a systematic way, by mapping the course content to each core learning element; this will enable the fulfillment of the main course objectives (Fink, 2013).

We believe that course design should be based on Core Learning Outcomes (CLOs) and not textbook driven. CLO statements refer to what the students are expected to know as well as what they are expected to be able to do upon completion of the course (Suskie, 2018). The CLOs should be measurable, observable, and performed by students (Suskie, 2018). Designing a course based on CLOs means building the course backwards from the CLOs to the methods that will enable the students to meet the CLOs (Onodipe, Ayadi, & Marquez, 2016). This involves identifying the CLOs, then defining the learning objectives, after that developing the content and supporting materials that will result in meeting the CLOs, and applying assessment methods that will determine the degree to which the CLOs are met.

In FTF classes, a high percentage of the information is shared verbally through interaction with the instructor. This is not currently possible with online courses but might be available in the future. Thus, the material must be reconfigured to meet the learning objectives via online delivery. This paper presents a framework for designing online courses in Operations Management based on Gagné's Nine Events of Instruction. It includes

a student-centric series of events that focus on the outcomes of learning instruction (Gagné, Wager, Goals, & Kelle, 2005).

This paper uses a case-study approach to demonstrate effective course design techniques. While it illustrates the concepts based on an undergraduate Operations Management course, we believe that the methodology can be applied to other topics/disciplines, particularly those that are both mathematical and conceptual in nature. A typical course on Operations Management discusses topics such as forecasting, product design, process planning, facilities layout and location, aggregate planning, inventory control, just-in-time manufacturing, quality control, scheduling, supply chain management, and other topics.

LITERATURE REVIEW

An efficient and standardized course design decreases the amount of time students must spend familiarizing themselves with the course structure, thus devoting more time to learning the course materials, which can result in improved learning outcomes (Ralston-Berg, Buckenmeyer, Barczk, & Hixon, 2015). Since adult learners don't have as much time to devote to their studies as traditional college students, the course materials need to be set up efficiently.

Cohen and Baruth (2017) studied the correlation between the "Big Five" personality traits (i.e., neuroticism, agreeableness, conscientious, extraversion, and openness to experience) and satisfaction with online learning. Personality traits impact students' learning styles. For example, students who displayed the extraversion personality trait learned better through group projects and hands-on activities. In addition, openness to experience and conscientiousness are significant predictors of students' satisfaction with their learning experience, but agreeableness was not a significant predictor. Since a given class will contain students with a wide variety of learning styles, it is important that online courses include a variety of media to cater to different learning styles. Jaggers and Xu (2016) studied how four design features influence students' course learning outcomes: (1) organization and presentation, (2) learning objectives and assessments, (3) interpersonal interaction, and (4) use of technology. The study found that the frequency and quality of student-to-instructor interaction had the greatest positive influence on students' learning outcomes. In addition, Lindstrom (1994) studied audience comprehension and retention of materials presented to a live audience and found that interaction can increase retention and comprehension. House (1999) found that the degree to which an online course included rich media and a high level of interaction between student and instructor and among other students were the biggest predictors of both self-reported student satisfaction rates and degree completion rates. Thus, it is important that designers facilitate student interaction with course material and each other. Ralston-Berg (2014) surveyed students to determine the most critical aspects contributing to their success in online education. They found that a well-organized course that is user-friendly and easy to navigate was the highest-rated factor. Therefore, course design must ensure ease of use from the student's perspective.

Shepherd and Martz (2006) surveyed 220 students in online courses to determine the type of media that resulted in the greatest student success. Their study found that richer media (measured by the number of technologies used by students, including email, forums, online announcements, and phone communications) was associated with better quality and quantity of communication in courses. Richer media was also associated with higher student satisfaction.

Taken together, these studies indicate that effective online courses include a variety of media to cater to the various learning styles, provide means for frequent and quality student to instructor interaction, are user-friendly/easy to navigate, and utilize richer media formats.

Although not specific to online courses, Gagné's Nine Events of Instruction are designed to facilitate engaging and meaningful instruction (Gagné et al., 2005). Gagné's Nine Events correspond to the conditions of learning and are based on a mental processing model of responses to stimuli that are designed to produce learning. Gagné assumes that different types of learning exist, and each type requires a different instructional condition for the desired learning outcomes to occur (Gagné et al., 2005). This paper is based on the following "events" that must be addressed for learning to effectively occur:

1. Gain attention.
2. Inform learners of objectives.
3. Stimulate recall of prior learning.
4. Present the content.
5. Provide "learning guidance."
6. Elicit performance (practice).
7. Provide feedback.
8. Assess performance.
9. Enhance retention and transfer to the job.

Solanki (2014) presented a framework for incorporating multimedia modules into the online classroom using Gagné's Nine Events of Instruction. The author's methodology involved using various multimedia to ensure that each of the Nine Events are triggered. Post-course evaluations from students revealed that incorporating several forms of multimedia, in addition to the traditional course components such as lecture notes and chapter summaries, improved students' retention of the material and catered to multiple learning styles.

Gokdemir, Akdemir, and Vural (2015) developed a learning management system (LMS) to help guide course developers to incorporate Gagné's Nine Events of Instruction in their course. Their LMS helped simplify the process of incorporating multimedia by providing templates that made it easy to insert various kinds of media and by providing placeholders indicating logical locations for the media. Feedback from both students and course developers indicated a positive experience with the LMS.

Miner, Mallow, Theeke, and Barnes (2015) evaluated the effectiveness of incorporating Gagne's Nine Events of instruction into online nursing education course design via student feedback from end-of-course surveys. Their study, taken over three consecutive semesters, found that incorporating Gagne's Events improved the students' enthusiasm for the course, their mastery of the material, and ultimately their final grades.

The Quality Matters (QM) rubric is an international standard for evaluating online and hybrid courses. It has established national quality standards for online courses, though a faculty-driven peer-review process (Maryland Online, Inc., 2014). QM provides eight broad quality standards, which can be further broken down into substandards if desired:

1. Course Overview and Introduction.
2. Learning Objectives (Competencies).
3. Assessment and Measurement.
4. Instructional Materials.
5. Learner Interaction and Engagement.
6. Course Technology.
7. Learner Support.
8. Accessibility.

Within each of the broad QM standards, there are approximately 4 or 5 substandards. Ultimately, the QM ratings are added together to determine an overall score, which will determine whether the minimum threshold for quality is met. Courses not meeting the threshold should be redesigned until the standard is met.

In a 2015 study, Ralston-Berg, Buckenmeyer, Barczk, and Hixon designed an experiment to determine whether QM standards truly determine quality in traditional and blended courses in addition to online courses. Via surveys, they confirmed that most of the time students did value items that QM determined to be essential and important, thus confirming its usefulness in a course development framework. Our methodology integrates both Gagne's Nine Events of Instruction and QM standards to achieve the best quality outcome in course design.

METHODS

This paper uses a case-study approach to illustrate the application of Gagné's Nine Events of Instruction for designing an online operations management course in Moodle 2.0. The course design starts by identifying what concepts to include. We suggest first developing time frames and goals with intermediate deliverables before beginning a course design process. When a plan has been established, the course content can be added. Typically, online courses have the following components:

- Course Objectives, Introduction, Syllabus
- Announcements
- Lectures and supplemental material (slides, notes, multimedia)
- Discussion Forum
- Assignments
- Exams

The course development process is iterative in nature (see Figure 1). The first step is to define course objectives. After that the course shell development commences. A cycle of application of Gagné's

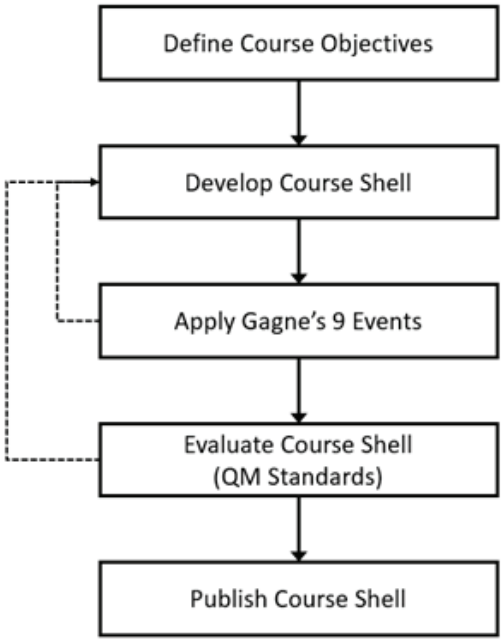


Figure 1. Framework For Online Course Development.

events and evaluating against QM standards is next, with changes to the course shell as needed. Once satisfactory course shell design is achieved, the resulting course shell is published.

This paper describes the results of applying Gagné's Nine Events of Instruction and the evaluation of the developed course shell using the QM rubric. It concludes by presenting design guidelines for efficient course design.

RESULTS

Best Practices

The syllabus should be the first item that is visible in an online course and should be easy to find (Onodipe et al., 2016). In a redesign from a traditional FTF course to an online version, the syllabus needs little updating. However, it is even more important than in a traditional environment to state the best way to contact the instructor and the expected turnaround time for grading and emails (Cydis, Galantino, Hood, Padden, & Richard, 2017). In addition, standard information such as textbook, course description, learning objectives, assignments, due dates, and point values should be included, as well as policies for accommodating disabilities. Essentially the syllabus is a "one stop shop" for students to find out the most important information about the course.

According to Jaggers and Xu (2016), frequent (at least weekly) announcements that include reminders, such as upcoming due dates, were linked to higher student satisfaction and better grades. We suggest preparing and scheduling announcements in advance and modifying them as needed to reflect discussions that have taken place in the current classroom, upcoming holidays, or other relevant current events. For example, in our Operations Management online course, we had a set of standard announcements and modified one of the announcements the week following a major natural event (e.g., hurricane) to state the policy on extended deadlines for those students affected by the event.

We propose that a standard design for an online course should include weekly discussion forums and an introduction forum in week one. Many online classes are eight to 16 weeks in duration. Those that follow the semester schedule have off weeks for holidays and school breaks. Semester courses can also omit a discussion during weeks when an exam is taken or a major assignment is due. Typically, a total of eight discussion topics per course, excluding the introduction forum, is sufficient. By settling on a standard of eight discussion topics per course, we can ensure that a three-credit-hour course contains the same amount of material whether it lasts eight

weeks or sixteen.

The first assignment in an online classroom should be the introductory forum. This forum increases the social presence, or feeling of community, in the classroom (Moore, 2013). Having an Instructor Background page that includes the instructor's photograph, contact info, and a brief biography is another way to help students feel a more personal connection to the instructor. A video introduction is an even better way to take this connection a step further (Garrison, Cleveland-Innes & Fung, 2010).

A typical protocol for discussions is to require students to post a minimum of two replies to classmates. The students' initial forum post is typically required to be a minimum of either 250 or 500 words and replies must generally be a minimum of either 100 or 200 words. We suggest that the course developer identify an appropriate post length and maintain this standard throughout the class; changing requirements for discussions from week to week is inadvisable, even when the standards are clearly stated, because this might be confusing for students (Onodipe et al., 2016).

The number of assignments will vary by course and should not change between the traditional and online delivery. We suggest including one assignment per week in undergraduate courses, excluding weeks that contain an exam or a major holiday. The final assignment should be a term paper, final presentation, case study, or other comprehensive assignment (Onodipe et al., 2016).

We encourage collaborative work in the online environment. Students are often geographically dispersed and work across multiple time zones. Thus, they rarely get to meet in person and often feel isolated (Garrison et al., 2010). Group projects can "build a learning community that encourages critical thinking, problem solving, analysis, integration, and synthesis; provides cognitive supports to learners; and ultimately promotes a deeper understanding of the material" (Jaggers and Xu, 2016, p. 4).

Develop CLOs

The first step in planning a course is to define clear and specific learning outcomes for students. When a course is being redesigned from a traditional delivery setting to an online or hybrid course, the learning objectives are already established and do not need to be modified. In other instances, the course objectives are provided to the course developer. Typical objectives in an undergraduate Operations Management course include:

1. Explain the principles and concepts of operations management and how they impact organizations in both manufacturing and service sectors.

2. Analyze the long-term vs. short-term uses of operations management tools/techniques.

3. Apply problem solving and quantitative techniques in different areas of operations management.

4. Apply different operations management concepts in a global context.

Course Design based on Gagne's Nine Events of Instruction

We discuss the ways in which we integrated each of the nine events into Operations Management instruction below.

Gain Attention

This refers to capturing the students' interest and ensuring that they understand why the material is important to them. Ideally the students should be stimulated by something novel and surprising (Dringus, Synder, & Terrell, 2010; Felder, 2016). In the FTF model of instruction, the instructor can simply start off the lecture with a narrative hook or interesting anecdote. In an online course, one method of gaining students' attention is through weekly announcements. The weekly announcements provide timely information to students and establish a foundation for setting expectations and reviewing outcomes. We suggest including a synopsis of the week's learning objectives and deliverables, as well as a statement of the importance of the learning objectives. The weekly announcements should also include relevant deadlines and other information that are pertinent to the students.

Another method of gaining attention in online courses is using a short video. For example, in our Operations Management class we start our section on Just In Time (JIT) Manufacturing with a video on JIT at Toyota. This helps the students appreciate the importance of the topic by explaining how Japanese automakers could become more profitable than US because of JIT, and it stimulates interest by showing the factory environment where JIT implementation first took place, which also provides

a context for applying the information.

Watkins (2005) recommends incorporating pop culture into lectures and discussions as another method of gaining attention. For example, when discussing a statistical concept such as hypothesis testing, an instructor may describe the example of testing whether a celebrity's new haircut has increased the amount of attention a celebrity has achieved on social media.

Inform Learners of Objectives

This step involves informing students of expectations and explaining how the CLOs will be met and how they will be assessed. The syllabus is part of this step. Assessment methods, grading scales, and expectations should be clearly spelled out in the syllabus. This is not different in the online and traditional modalities. We believe that it is important to communicate high expectations because students will typically live up to them. Setting expectations high often becomes a self-fulfilling prophecy; students make the extra effort to meet demands when they believe they are expected to meet them (Jamieson & Lohmann, 2012).

Rubrics are another method of setting expectations. In our operations management course, we used a rubric that clearly defined a category and the expectations for each category. Our rubric for papers is shown in Table 1.

Stimulate Recall of Prior Learning

In this step, the students' relevant prior knowledge from prerequisite classes or experience is called upon and related to the current topic of discussion. Learners can better understand and retain information by relating it to something they already know (Felder, 2016; Prasad, 2009). In an online environment, the discussion board is a perfect opportunity to bring up a discussion topic that relates to prior learning. This can happen in the form of a follow-up question to a student's initial reply to a discussion board posting. Figure 2 shows an example discussion question that might be typical in an Operations Management course.

The same could be accomplished in a traditional classroom environment through lecture. In an online learning environment, diligence is required on the part of the instructor, who can connect students to the post of another student who may share a similar experience related to the concept or even express a differing viewpoint. Connecting two students' discussions together not only fosters a sense of community, but students are more likely to retain the concepts being discussed (Mastropieri & Scruggs, 2017).

Present the Content

A class will typically be composed of students with a variety of learning styles (Zapalska & Brozik, 2006). Presenting the material in a variety of ways will cater to a wide variety of learning styles and improve retention for more students (Kauffman, 2015). Resources that present multiple viewpoints are encouraged. A recorded lecture or video might be a nice supplement to student slides and handouts. In addition, multimedia, websites, graphics, audio, and even periodicals may provide worthwhile media for presenting the course material. We encourage redundancy in the presentation of the material because this allows students to choose the type of material that best caters to their needs and promotes flexibility of the learning environment. Some examples of supplemental materials used in our Operations Management course are videos of a Walmart distribution center, articles describing recent Lean and Six Sigma implementations, and journal articles describing relevant case studies.

One of the most important aspects of effective course design is facilitation of instructor to student interaction (Kauffman, 2015; Standlee, 2016). Live lectures are helpful to cover some of the more mathematical concepts of operations management in depth, such as linear regression and the calculation of control limits for quality control, particularly for students who feel challenged by math (Fink, 2013). In an online course, this concept can be explained live via Adobe Connect sessions, so students can ask questions, or via a prerecorded session. We offered an optional, weekly synchronous session for students to ask for clarification with the mathematical concepts covered in our class.

Provide "Learning Guidance"

Learning guidance helps learners to encode the presented information for long-term storage (Buscombe, 2013; Mann, 2002). Types of learning guidance include examples, counter-examples, analogies, graphs, and case studies. In a traditional classroom, learning guidance is mainly provided during the instructor's lecture, either verbally or using supplemental slides. In an online environment, the discussion board is an

Table 1: Paper Grading Rubric.

Category (Weight)	Exceeds Expectations (A)	Meets Expectations (B)	Doesn't Meet Expectations (C)	Score
Format/Structure (20)	1. Includes a cover page with name, date, course name and number, neat finish, no errors 2. Includes Introduction, Background, Methods, Results, and Discussion 3. Demonstrates logical and subtle sequencing of ideas 4. Uses well-developed paragraphs	Evidence of 3	Evidence of 2 or fewer	
Introduction (20)	1. Clearly states need 2. Includes problem definition	Evidence of 1	No evidence	
Body (20)	1. Provides sufficient background to justify hypothesis 2. Includes well-developed hypothesis 3. Method is clear and justified 4. Results are presented clearly 5. Results are discussed in context of background	Evidence of 4	Evidence of 2 or fewer	
Conclusion (20)	1. Conclusions are identified based on discussion of results 2. Conclusions are well-thought through and concisely presented 3. Includes follow-up work	Evidence of 2	No evidence	
Citations (20)	1. Includes a reference list 2. Citations are properly used within the document 3. Includes 5or more major references and fewer than 2 internet sites	Evidence of 2	Evidence of 1 or none	

Describe the various ways materials management professionals match supply to demand. What uncertainties must they consider? What are the consequences of ineffective inventory management? Your main post should be at least 250 words and you must reply to at least 2 classmates for a minimum of 100 words each. Remember to cite your sources.

Post your discussion in the forum, not as an attachment, and be sure to cite references using APA format including in-text citations.

Figure 2. A Sample Discussion Question

opportunity to provide learning guidance from both the instructor and peers. In these boards, the instructor should present thought-provoking follow-up questions that not only test the students' knowledge of the material but also relate their knowledge to real-world experience. The instructor can also post examples of how the concepts relate to their industry experience. Classmates should be encouraged to ask follow-up questions regarding the information provided in the initial posts.

Other ways to deliver learning guidance include providing chapter outlines, study guides, and practice exams. Online instructors should have office hours and be available by phone and perhaps video chat. Screen sharing services such as Adobe Connect are often useful, particularly in operations management when demonstrating the use of spreadsheet or statistical software packages.

Elicit Performance (Practice)

Students appreciate having the opportunity to assess their learning frequently via quizzes that are either low-point-value or practice quizzes. Students enjoy nongraded quizzes because they are nonthreatening, low-stress, and are an excellent opportunity to provide feedback (Hirumi, 2014). Since Operations Management is quite mathematical in nature, we advise assigning weekly math problems or case studies. In addition, we assigned shorter math problems in five additional weeks. These short math assignments were completed online and autograded, revealing the students' scores and feedback instantly. Each week, students had either a short quiz, case study, midterm, final exam, or final project due. As a result, students can receive frequent feedback in different forms, which can help them understand the mathematical concepts (Garrison et al., 2010).

Students who utilize the course material in practical rather than theoretical ways are more likely to retain the material. For example, after discussing the impact of a natural disaster on a supply chain, students can then be asked to simulate this scenario and develop work-arounds to keep the supply chain moving. Online simulation programs such as SCM Globe are relatively low in cost and straightforward to learn, and they provide an excellent medium for individual or group projects. Practical learning platforms also tend to increase students' satisfaction with the course (Cohen & Baruth, 2017).

Provide Feedback

Research shows that students benefit from receiving a wide variety of feedback (Jaggers & Xu, 2016; Zapalska & Brozik, 2006). This not only caters to various learning styles but also provides a contrast between the instant but trivial feedback in the form of autograded quizzes and the in-depth and individualized feedback that an instructor provides for a case study or a term paper. In our Operations Management online classroom, feedback came from several sources: from both instructor and peers on the discussion board, from the instructor on case studies and the final project, and automatically from the autograded exams and quizzes.

Whenever possible, rubrics should be used when providing feedback. The instructor should make comments directly on the rubric indicating why the student's work meets each category that was selected.

Assess Performance

Assessments are methods for evaluating the CLOs and should be designed with this objective in mind (Hales & Marshall, 2004). Two types of assessments are summative and formative. Summative assessments evaluate students' mastery of the material at the end of the instructional period or term, whereas formative assessments provide feedback to students through either formal or informal processes throughout the term (Maki, 2004). Both types of assessments are critical to student success. Formative assessments can identify sources of misunderstanding and provide the student with additional clarity before moving from one concept or lesson to another.

Informative assessments not only assess student learning but also help to guide the instructor's delivery of future materials. Informative feedback is often more important in an online environment than a traditional environment because students feel isolated due to a lack of nonverbal and visual signals (Hales & Marshall, 2004).

Students, especially undergraduates, need frequent opportunities to reflect on what they have learned and any areas where they still need clarity. We recommend having several major milestones, some of which may be ungraded, in which the students can receive feedback on their paper. In this

Project Schedule

WEEK	DUE
1	Discussion of project, expectations (ungraded, but required)
2	Discussion of project, expectations (ungraded, but required)
3	Proposal/Outline* (ungraded, but required)
7	Term Project Due (graded deliverable)

* Present your improvement project in terms of at least 2 inputs, 2 transformations, and 2 outputs. You must also name all 6 measures of performance you plan to track/monitor.

Figure 3. Course Project Milestones

course, we included several ungraded but required milestones that allow students to receive feedback on their project. These milestones are outlined in Figure 3.

Another efficient method of developing assessments involves the use of a test bank. Often, test banks are provided by the authors of textbooks and need only be imported to the LMS. In some online courses, academic integrity is a concern. In these cases, we suggest randomly assigning a subset of the available questions to each student. This way, if two students tried to work together on an exam, they would not see the same questions at the same time. The autograding and autoimport aspect of these test banks save time for course developers and instructors. We used this method for our final exams in our class and for weekly quizzes.

The main methods of assessing performance in our Operations Management course are case studies, a final exam, and a final term project. In our sixteen-week class, three mathematical case studies were assigned. These case studies consisted of real-word problems including calculating productivity at a restaurant, performing forecasting, and performing scheduling calculations.

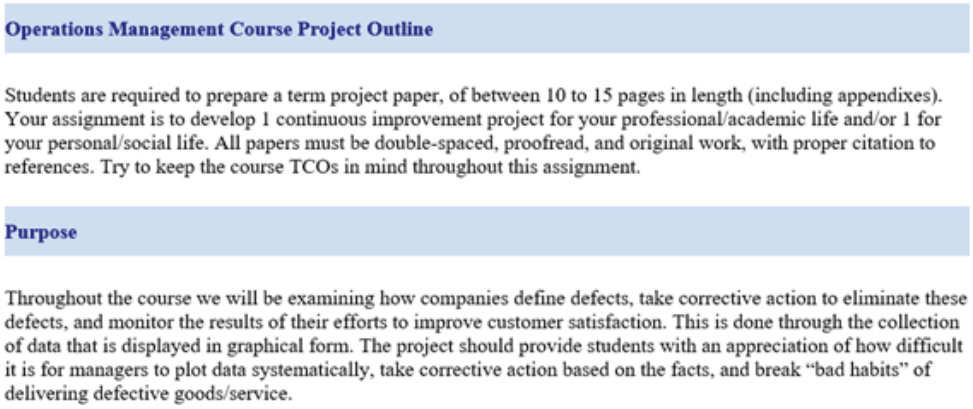
The assignment that carries the most weight in terms of the final grade in our Operations Management class is the term paper project. Students are assigned a term paper to develop a continuous improvement project for their professional or academic life. Throughout the course we examined how companies define defects, take corrective action to eliminate these defects, and monitor the results of their efforts to improve customer satisfaction through the collection of data that is displayed in graphical form. The project provides students with an appreciation of how difficult it is for managers to plot data systematically, take corrective action based on the facts, and break "bad habits" of delivering defective goods/services. They were required to present their improvement project in terms of at least two inputs, two transformations, and two outputs, and to name the six measures of performance they tracked. The instructions for the final project are described in Figure 4.

Enhance retention and transfer to the job

As mentioned previously, we assigned case studies using real-world data from a restaurant. The same restaurant was used for each of the three cases, but a different aspect of the business was studied in each. This allows students to connect what was studied in class to real-world situations. Retention and understanding are improved if material is learned in the context within which it will be used (Kolb, 2015; Mann, 2002; Mastropieri & Scruggs, 2017). For this reason, the case study was designed to mimic the tasks that an Operations Manager would be expected to complete on the job as closely as possible.

Below is an excerpt from the table that was used by us to evaluate the QM Standards for our Operations Management course, which was developed in Moodle 2.0. The table indicates how the standards 'Assessment and Measurement' and 'Instructional Materials' were met.

By systematically checking that each standard was addressed, we ensured that our learning objectives can be met and our course is of high quality. However, this does not mean that the course is in its final state after a single iteration of development; course design should be a process of continuous improvement that takes student and instructor feedback into consideration each time the course is taught.



Operations Management Course Project Outline

Students are required to prepare a term project paper, of between 10 to 15 pages in length (including appendixes). Your assignment is to develop 1 continuous improvement project for your professional/academic life and/or 1 for your personal/social life. All papers must be double-spaced, proofread, and original work, with proper citation to references. Try to keep the course TCOs in mind throughout this assignment.

Purpose

Throughout the course we will be examining how companies define defects, take corrective action to eliminate these defects, and monitor the results of their efforts to improve customer satisfaction. This is done through the collection of data that is displayed in graphical form. The project should provide students with an appreciation of how difficult it is for managers to plot data systematically, take corrective action based on the facts, and break "bad habits" of delivering defective goods/service.

Figure 4. Term Project Outline.

Table 2. Addressing QM Standards in Operations Management Course.

Standard	How the Standard is Addressed
3.1 The assessments measure the stated learning objectives or competencies.	The questions being asked on the assessments align with the objectives. The higher-level objectives are assessed within the case-study assignments.
3.2 The course grading policy is stated clearly.	The grading policy is stated on the syllabus.
3.3 Specific and descriptive criteria are provided for the evaluation of students' work.	Grading rubrics are included.
3.4 The assessment instruments selected are sequenced, varied, and appropriate to the student work being assessed.	Types of assessments include discussion boards, case studies, exams, and a final project.
3.5 The course provides learners with multiple opportunities to track their learning progress.	There are two methods of assessment each week—a weekly discussion forum and one of the following: case study, ungraded quiz, exam, or final project.
4.1 The instructional materials contribute to the achievement of the stated course and module learning objectives or competencies.	The instructional materials appear to support the course objectives.
4.2 The purpose of instructional materials and how the materials are to be used for learning activities are clearly explained.	Directions are given within the discussion forums. The discussion questions are tied to the supplemental materials.
4.3 All instructional materials used in the course are appropriately cited.	Textbook and linked supplemental materials are provided.
4.4 The instructional materials are current.	All instructional materials have been created within the last decade.
4.5 A variety of instructional materials is used in the course.	Text, videos, and websites are utilized.
4.6 The distinction between required and optional materials is clearly explained.	There are no optional materials in this course.
5.1 The learning activities promote the achievement of the stated learning objectives or competencies.	The learning activities in the course support the objectives. Case studies and the final project give students the opportunity to demonstrate their ability to apply their knowledge.
5.2 Learning activities provide opportunities for interaction that support active learning.	There is a weekly discussion question that encourages interaction among students.
5.3 The instructor's plan for classroom response time and feedback is clearly stated.	A statement on the syllabus describes expected turnaround time for grading assignments.
5.4 The requirements for	Discussion forum rubric states the expected number of replies and minimum word count.

Course Feedback

After we taught the course for the first time after implementing our course development methodology, we examined the students' feedback from end-of-course surveys to look for opportunities for improvement. One thing that stood out was that the students did not generally come to a consensus on the most beneficial components of the course. Some students appreciated the multimedia while others chose not to utilize it. This reiterates the need to address students' varying learning styles. A few students requested summary PowerPoint slides of the required reading for the week from the textbook. We added these summary slides for the second iteration of teaching the class.

Course feedback also revealed that although the late policy was posted in the syllabus, some students still claimed ignorance of the policy. To remedy this, we began to upload a separate document labeled "Late Policy." In addition, we placed links to the late policy and each assignment's rubric in the assignment instructions.

One of the most important pieces of feedback from students indicated that they would have appreciated a review session on statistical concepts such as hypothesis testing. This led us to do the following: 1) Add a live session via Adobe Connect for the instructor to walk through a hypothesis test and give students the opportunity to ask questions, and 2) post a video of this session to the classroom for students who were unable to attend the live session or who need a review. The video was included in our classroom for future iterations of teaching the class.

Many LMSs will generate reports indicating the number of views or clicks on each course component. This data can provide course developers with data related to which items are being used the most. This can help course developers decide which type of media to focus on when revising courses.

CONCLUSIONS

We have presented a framework for efficient course design utilizing an undergraduate Operations Management course as a case study. Our method is based on Gagne's Nine Events. Through the application of Gagne's Nine Events to the development of the online operations management course, and based on student and instructor feedback from three semesters of teaching the course, the following design guidelines can be extracted:

- Include a syllabus as the first item that is visible in an online course (Cydis etal., 2017)
- Prepare and schedule announcements in advance, and modify them as needed to reflect discussions that have taken place in the current classroom, upcoming holidays, or other relevant current events (Cohen & Baruth, 2017)
- Include weekly discussion forums, generally eight per course, in addition to an introduction forum in week one (Kauffman, 2015)
- Require students to post a minimum of two replies to classmates in weekly discussion forums (Kauffman, 2015)
- Provide an Instructor Background page that includes the instructor's photograph, contact info, and a brief biography (Cohen & Baruth, 2017)
- Include one assignment per week. The final assignment should be a term paper, final presentation, case study, or other comprehensive assignment (Fink, 2013)
- Include weekly announcements to provide just-in-time information to students and establish the foundations for setting expectations and reviewing outcomes (Jaggers & Xu, 2016)
- Prioritize ease of navigation, even when that means incorporating redundancy (Ralston-Berg, 2014)
- Consider using multimedia, websites, graphics, audio, and periodicals for presenting the course material (Dringus et al., 2010; Mastropieri & Scruggs, 2017)
- Consider including course components that contain interaction as well as auditory and visual presentation of the material, such as a forum that requires students to watch a video and then post an analysis of the video (Solanki, 2014)
- Consider posting relevant examples of how the concepts relate to the instructor's industry experience (Kolb, 2015)
- Present the material in redundant ways so students can choose their preferred method based on their learning style (Garrison et

al., 2010)
- In the absence of a lecture, include summary slides of the course material
- Structure the course so that students apply the material as closely to the way in which they will use the material in the real world (i.e., use case studies and/or simulations) (Garrison et al., 2010)
- Provide learning guidance such as chapter outlines, study guides, and practice exams (Buscombe, 2013)
- Assess student learning frequently via quizzes that are either low-point-value or practice quizzes (Suskie, 2018)
- When appropriate, use rubrics to provide feedback to students (Fink, 2013)
- When appropriate, include several ungraded but required milestones that allow students to receive feedback on their projects/assignments (Suskie, 2018)
- When appropriate, include autograded quizzes that provide students with instant feedback to test their knowledge of key course terms and concepts (Suskie, 2018)
- Offer a live session and/or a video recording of the instructor explaining advanced mathematical concepts
- Continue to improve the course iteratively, after considering feedback from end-of-course surveys and reports regarding student usage of the material provided by the LMS
- The specific application of Gagne's principles will depend on the course element under consideration and the capabilities of the chosen LMS

The resulting course design was evaluated against the QM rubric, where (among other considerations):

- The questions being asked on the assessments align with the objectives and the higher-level objectives are assessed within the case study assignments (Suskie, 2018)
- The grading policy is stated on the syllabus
- Grading rubrics are included
- There are several different types of assessment in this course, including discussion boards, case studies, exams, and a final project (Suskie, 2018)
- There are two methods of assessment each week—a weekly discussion forum and one of the following: case study, ungraded quiz, exam, or final project
- Directions are given within the discussion forums. The discussion questions are tied to the supplemental materials
- Textbook and linked supplemental materials are provided
- All instructional materials have been created within the last decade

We believe that by utilizing our framework, course developers can achieve a more effective learning environment, allowing instructors to be more organized and students to better meet their learning objectives. Our course design framework stimulates critical thinking and better retention and transferability, particularly due to the elements of soliciting learning guidance, presenting the content in multiple modalities, and relating the material to prior learning and expected future usage. Our course design also facilitates frequent instructor to student interaction and feedback, key components to student success, higher satisfaction and student retention. Our methodology is iterative and takes into consideration the feedback from prior course evaluations and instructor feedback, leading to continuous improvement in course quality. The ultimate result is an efficient framework for designing online or hybrid courses that also improves the quality of the learning environment.

References

Allen, I., & Seaman, J. (2014). Grade change: Tracking education in the United States. Oakland, CA: Babson Survey Research Group.

Buscombe C. (2013). Using Gagne's theory to teach procedural skills. The Clinical Teacher, 10(5), 302–307. doi:10.1111/tct.12051

Cohen, A., & Baruth, O. (2017). Personality, learning, and satisfaction in fully online academic courses. Computers in Human Behavior, 72, 1–12. doi:10.1016/j.chb.2017.02.030

Christensen, C., & Eyring, H. (2011). The innovative university: Changing the DNA of higher education from the inside out. San Francisco, CA: John Wiley & Sons.

Cydis, S., Galantino, M., Hood, C., Padden, M., & Richard, M. (2017). Integrating and assessing essential learning outcomes: The syllabus and formative feedback. Journal of Learning in Higher Education, 13(2), 81–97.

Dringus, L., Synder, M., & Terrell, S. (2010). Facilitating discourse and enhancing teaching presence: Using mini audio presentations in online forums. Internet and Higher Education, 13(1-2), 75–77. doi:10.1016/j.iheduc.2009.11.001

Felder, R. (2016). Rethink Traditional teaching methods to improve learning and retention. Journal of STEM Education, 17(1), 58–60. Retrieved from https://www.learntechlib.org/p/173702/

Fink, L. (2013). Creating significant learning experiences: An integrated approach to designing college courses. San Francisco, CA: Josey-Bass.

Gagne, R. M., Wager, W. W., Goals, K. C., & Kelle, J. M. (2005). Principle of instructional design (5th Ed.). Belmont, CA: Thomson Learning, Inc.

Garrison, D. R., Cleveland-Innes, M., & Fung, T. S. (2010). Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. The Internet and Higher Education, 13(1-2), 31–36. doi:10.1016/j.iheduc.2009.10.002

Gokdemir, A., Akdemir, O., & Vural, O. (2015). Using Gagne's Nine Events in learning management systems. Cypriot Journal of Educational Sciences, 10(1), 18–31. doi:10.1016/j.sbspro.2013.12.376

Hales, L. W., & Marshall, J. C. (2004). Developing effective assessments to improve teaching and learning. Norwood, MA: Christopher-Gordon Publishers, Inc.

Hirumi, A. (Ed.) (2014). Grounded designs for online and hybrid learning. Washington, DC: International Society for Technology in Education.

House, J. (1999). The effects of entering characteristics and instructional experiences on student satisfaction and degree completion: An application of the input-environment-outcome assessment model. International Journal of Instructional Media, 26(4), 423.

Jaggers, S., & Xu, D. (2016). How do online course design features influence student performance? Computers & Education, 95, 270–284. doi:10.1016/j.compedu.2016.01.014

Jamieson, L. H., & Lohmann, J. R. (2012). Innovation with impact: Creating a culture for scholarly and systematic innovation in engineering education. Washington, DC: American Society for Engineering Education. Retrieved from http://www.asee.org/member-resources/reports/Innovation-with-Impact

Kauffman, H. (2015). A review of predictive factors of student success in and satisfaction with online learning. Research in Learning Technology, 23, 1–13. doi:10.3402/rlt.v23.26507

Kolb, D. (2015). Experiential learning: Experience as the source of learning and development. Upper Saddle River, NJ: Pearson Education, Inc.

Lindstrom, R. (1994). The Business Week guide to multimedia presentations: Create dynamic presentations that inspire. New York, NY: McGraw-Hill.

Maki, P. L. (2004). Assessing for learning: Building a sustainable commitment across the institution. Sterling, VA: Stylus.

Mann, K. V. (2002). Thinking about learning: Implications for principle-based professional education. Journal of Continuing Education in the Health Professions, 22(2), 69–76. doi:10.1002/chp.1340220202

Maryland Online, Inc. (2014). Quality Matters higher education rubric (5th Ed.). Annapolis, MD: Author.

Mastropieri, M., & Scruggs, T. (2017). The inclusive classroom: Strategies for effective differentiated instruction. Upper Saddle River, NJ: Pearson Education, Inc.

Miner, A., Mallow, J., Theeke, L., & Barnes, E. (2015) Using Gagne's 9 Events of Instruction to enhance student performance and course evaluations in undergraduate nursing course. Nurse Education, 40(3), 152–154. doi:10.1097/NNE.0000000000000138

Moore, M. (2013). The theory of transactional distance. Handbook of distance education (3rd ed.). New York, NY: Routledge.

Onodipe, G., Ayadi, M., & Marquez, R. (2016). The efficient design of an online course: Principles of economics. Journal of Economics and Economic Education Research, 17(1), 39.

Prasad, D. (2009). Empirical study of teaching presence and critical thinking in asynchronous discussion forums. International Journal of Instructional Technology and Distance Learning, 6(11), 1–10.

Ralston-Berg, P. (2014). Surveying student perspectives of quality: Value of QM rubric items. Internet Learning, 3(1), 117–126.

Ralston-Berg, P., Buckenmeyer, J., Barczk, C., & Hixon, E. (2015).

Students' perceptions of online course quality: How do they measure up to the research? Internet Learning Journal, 4(1), 38–57.

Shepherd, M. M., & Martz Jr., W. B. (2006). Media richness theory and the distance education environment. Journal of Computer Information Systems, 47(1), 114–122. doi:10.1080/08874417.2006.11645945

Solanki, R. (2014). Developing instructional multimedia module incorporating Gagne's Nine Events of Instruction. The Journal of Education, 2(1), 1–16.

Standlee, A. (2016). Technology and making meaning in college relationships: Understanding hyper-connectivity. Qualitative Sociology Review, 12(2), 6–21.

Suskie, L. (2018). Assessing student learning: A common sense guide (2nd Ed.). Bolton, MA: Anker Publishing Company.

Watkins, R. (2005). 75 e-Learning activities: Making online learning interactive. San Francisco, CA: Pfeiffer.

Zapalska, A., & Brozik, D. (2006). Learning styles and online education. Campus-Wide