

4-3-2015

## Increasing Knowledge by Leaps and Bounds: Using Experiential Learning to Address Threshold Concepts

Thomas P. Bradley  
*Tarleton State University*

Gerald F. Burch  
*Tarleton State University*

Jana J. Burch  
*Tarleton State University*

Follow this and additional works at: <https://scholarship.shu.edu/omj>



Part of the [Organizational Behavior and Theory Commons](#), and the [Organizational Communication Commons](#)

---

### Recommended Citation

Bradley, Thomas P.; Burch, Gerald F.; and Burch, Jana J. (2015) "Increasing Knowledge by Leaps and Bounds: Using Experiential Learning to Address Threshold Concepts," *Organization Management Journal*. Vol. 12: Iss. 2, Article 8.

Available at: <https://scholarship.shu.edu/omj/vol12/iss2/8>

# Increasing Knowledge by Leaps and Bounds: Using Experiential Learning to Address Threshold Concepts

Thomas P. Bradley,<sup>1</sup> Gerald F. Burch,<sup>1</sup> and Jana J. Burch<sup>2</sup>

<sup>1</sup>College of Education, Tarleton State University, Stephenville, Texas, USA

<sup>2</sup>Department of Marketing, Tarleton State University, Stephenville, Texas, USA

---

The discussion of threshold concepts is growing in the management education literature. These concepts create challenges for students and instructors since they act as barriers to learning. The reward for overcoming these obstacles is the opening of new ways of thinking that were not available before the student mastered the threshold concepts. We propose in this article that many students believe business education is “common sense” and do not understand that management is practice informed by theory. When students master the threshold concept concerning the “underlying game” of management, they begin to develop deeper and more meaningful understandings. From this perspective we demonstrate how we have used experiential exercises in an operations management class to facilitate active, social, and creative learning that exposes this threshold concept and moves the student through the preliminal, liminal, and postliminal stages of threshold concept mastery. *Organization Management Journal*, 12: 87–101, 2015. doi: 10.1080/15416518.2015.1037044

---

**Keywords** threshold concepts; experiential learning; curriculum design; active learning

Threshold concepts have received considerable attention in recent management education research (see Meyer & Land, 2005). By their definition, threshold concepts represent those topics that when learned result in the student “seeing things in a new way” (Meyer & Land, 2003, p. 1). They are also potential stumbling blocks for students, since threshold concepts acts as barriers to further understanding. Until the student masters the threshold concept, the student is “stuck” and may engage in surface learning instead of deep learning (Davies & Mangan, 2006). However, when the student engages the threshold concept and makes sense of the new knowledge, the student is transformed, never to see the world the same way again.

From a curriculum perspective, threshold concepts may act as gatekeepers that prevent students from understanding key concepts and any further related information. An example is the

threshold concept of standard deviation, which is a troubling concept for many students. It is possible that standard deviation is introduced in the second week of a statistics class and is used every week thereafter in that course and further used in other university courses. The student who does not master the threshold concept of standard deviation begins to surface learn. The student may be able to calculate the standard deviation, perhaps even the probability when given a mean and a standard deviation, but will never be able to use the standard deviation in a conceptual way.

A higher order of threshold conceptions has also been identified where students do not understand how concepts work within a discipline (Burch, Burch, Bradley, & Heller, 2014). Wright and Gilmore (2012) showed that management students often do not understand the “underlying game” that management is practice supported by theory. Many students think that management is common sense and therefore do not spend the time and energy learning the theory that supports the practice, or students shape their perception of the entire business process based on limited, previous work experience (Walsh & Borkowski, 2014). The call from management education scholars is to identify these threshold concepts and conceptions, and find ways to address them.

In this article we propose that one means of addressing threshold concepts is to use experiential learning exercises. We examine the threshold concept literature and demonstrate how we have used the experiential learning structure proposed by Wolfe and Byrne (1975) to guide operations management students through the stages of mastering the threshold conception that management is not all common sense. We conclude the article with recommendations for current users of experiential learning and for those who do not currently use them, so that doors may be opened and students may move forward with their education in leaps and bounds.

## INTRODUCING THRESHOLD CONCEPTS

The notion of threshold concepts was introduced by Meyer and Land (2003) to explain why some concepts lead to what Perkins (1999) referred to as troublesome knowledge. In an

---

Address correspondence to Thomas P. Bradley, College of Education, Tarleton State University, P.O. Box 0330, Stephenville, TX 76402, USA. E-mail: [tbradley@tarleton.edu](mailto:tbradley@tarleton.edu)

attempt to address constructivism in education, Perkins (1999) looked at how knowledge makes trouble for learners, and how educators should address those events when troublesome knowledge occurs. In this context, troublesome knowledge is defined as knowledge that appears to be counterintuitive, alien, or incoherent (Perkins, 1999, 2006). Understanding the different types of knowledge helps identify which types of knowledge may become troublesome.

Perkins (1999) stated that the individual always has to construct or reconstruct what things mean. Individuals do this by using five kinds of knowledge that often lead to troubling consequences. These types of knowledge are inert, ritual, conceptually difficult, foreign knowledge (Perkins, 1999), and tacit knowledge (Perkins, 2006). Inert knowledge is information that is rarely called upon. An example is passive vocabulary that the individual knows but rarely uses. Ritual knowledge is often related to procedural steps where the student knows to invert and multiply when dividing by a fraction, but may not know why he or she inverts and multiplies. Conceptually difficult knowledge is that knowledge where the person finds what he or she is being told does not match what that person already knows or has observed. Foreign knowledge is somewhat similar to conceptually difficult knowledge, since the student does not know or understand the perspective that was used to construct the understanding or knowledge. An example is the understanding of the actions of one ethnic group, when viewed by another ethnic group that does not share similar beliefs, values, or understandings. Until the world is looked at through the foreign perspective, the understanding will never be gained. Meyer and Land (2003) added that tacit knowledge is also a type of troublesome knowledge since it is knowledge that we act upon but are only peripherally aware of or are entirely unconscious of (Perkins, 2006). An example that Perkins (2006) used was that of mathematical problem-solving techniques that were devised by Polya (1954, 1957) and that most students use without understanding or even knowing about what Polya wrote. When students use currently adopted mathematical comparison methods, they do not know the underlying ideas Polya used to develop these means of comparison.

Meyer and Land (2003) looked at various forms of troublesome knowledge in teaching economics at a university in the United Kingdom. What they found was that the mastery of some forms of troublesome knowledge resulted in the student seeing the world in a different way. Concepts, by their very nature, serve as the building blocks of knowledge to shape the discipline. However, threshold concepts lead to “substantial leaps in understanding” (Wright & Gilmore, 2012, p. 615) since they serve as “conceptual gateways” or “portals” (Meyer & Land, 2003). The doors open the student’s understanding of the world in a very different way, and do so in such an integrative manner that the student may never be able to go back to viewing the world as he or she did before. Threshold concepts are therefore transformative, integrative, and bounded, and hold irreversible characteristics (Meyer & Land, 2003). Examples of

threshold concepts are opportunity costs in economics (Davies & Mangan, 2006), gravity in physics (Irvine & Carmichael, 2009), and complex numbers and limits in mathematics (Scheja & Pettersson, 2010).

Wright and Gilmore (2012) further investigated threshold concepts in management and argued that the troublesome nature of some threshold concepts comes from the way concepts work together to create an underlying game (Perkins, 2006), instead of from the individual concepts themselves. Land and his colleagues (Land, Cousin, Meyer, & Davies, 2005) referred to these types of threshold concepts as threshold conceptions since they bind together aspects of a concept and how that concept may be viewed by those practicing in a specific discipline.

A threshold conception recently uncovered is that undergraduate management students do not understand the “underlying game” of management. Students in introductory management courses have management experiences that they have gained as employees, as consumers, and as team participants (Wright & Gilmore, 2012). Whetten (2007) stated that this experience leads students to the misconception that management is “common sense.” Students therefore have a threshold conception about management and do not realize that it is practice that is grounded in research (Burch, Burch, Bradley, & Heller 2014).

## HOW TO ADDRESS THRESHOLD CONCEPTS

After acknowledging that threshold concepts exist, it is imperative to discuss how to introduce students to these concepts. Perkins (2006) argues that students will not learn unless they rediscover Greek philosophy or Newton’s laws for themselves. Threshold concepts therefore require a level of struggle that the student must undertake to master. The student often needs to wrestle with opening the door to appreciate what is on the other side.

Phillips (1995) stated that there are three distinct roles in learning through constructivist processes that may be helpful to mastering troublesome knowledge. Active learning requires actively gaining knowledge and learning, social learning is where knowledge is socially constructed, and creative learning is where knowledge and understanding are created or recreated. These roles have the potential to address threshold concept learning since they allow the educator to challenge the student and move the student across the “transformational landscape” (Meyers & Land, 2005, p. 279) of threshold concepts and threshold conceptions. Students will naturally become “stuck” and be forced to actively create or recreate their perceptions of reality, either by themselves or socially, in a manner that will change their view of the world. This is in stark contrast to those students who adopt a surface learner approach to the concept and meet the course requirements through rote learning, mimicry, or other passive means that result in no transformation in thought (Ramsden, 2003).

A major challenge for educators is to design a course, embedded with specific exercises, that allows for the uncovering of knowledge. Meyer and Land (2003) stated that there are three

distinct steps required to ensure the student moves through the conceptual portal. The first is the *preliminal* (from Latin *limen*, threshold) stage where the student has not crossed the threshold, the *liminal* stage where the student is at the threshold, and the *postliminal* stage where the student has a new understanding based on moving through the threshold. Educators must first develop ways to “listen for understanding” to determine where the student is (Land et al., 2005) on the liminality scale, perhaps by developing activities to expose the student’s understanding of the threshold concept (Davies & Mangan, 2006). Wright and Gilmore (2012) developed a process of identifying preliminary students and then coaxing them to become confused and frustrated. At this point the student begins to reconstruct his or her ideas based on the new levels of knowledge either alone or socially. The student is holding on to his or her old way of thinking, while moving to a new way of thinking. This is like a child on the monkey bars, who with one hand reaches for the new knowledge while holding on to the past in the *preliminal* stage, briefly holds on to both bars in the *liminal* stage, and then releases with the first hand to move forward in the *postliminal* stage, thereby mastering the threshold concept with an active learning that is led by the instructor.

This discussion of threshold concepts illustrates a perfect scenario for which to use experiential learning. In the next section we briefly outline the definition of experiential learning and develop a framework to connect threshold concepts to experiential learning.

### USING EXPERIENTIAL LEARNING TO ADDRESS THRESHOLD CONCEPTS

“Experiential learning exists when a personally responsible participant cognitively, affectively, and behaviorally processes knowledge, skills, and/or attitudes in a learning situation characterized by a high level of active involvement” (Hoover & Whitehead, 1975, p. 25). In essence, the “student can learn from experience” (Gentry, 1990, p. 9). Embedded in this definition are many concepts; however, the one of most import to this discussion is that of learning being the result of active involvement with the subject. Again, the mental image is of the student actively wrestling with the concepts until new knowledge is developed and integrated in such a way that the student can use that knowledge.

One task structure outlined by Wolfe and Byrne (1975) stated that experientially based exercises should involve four phases: design, conduct, evaluation, and feedback. In the design phase the instructor determines the learning objective, selects the activity, identifies the factors affecting student learning, and lays the theoretical base so that the participant views the activity through the desired lens (Gentry, 1990). In the conduct phase the instructor maintains and controls the learning by altering the design as necessary to ensure the experience is structured and arrives at the desired outcome. During the evaluation phase the instructor allows the student to evaluate his or

her experience. Although the feedback phase is listed last, the participant should receive reinforcing information throughout the conduct and evaluation phases to help guide his or her learning. Preassessment can further identify misconceptions before teaching begins, thereby allowing feedback to address common learning barriers.

This task structure outlines the required dimensions needed to address threshold concept stages and learning. We first address how experiential learning can be used to move the student through the threshold concept liminality stages and then propose a means of using the experiential learning structure to create active, social, and creative learning to address the threshold conception that management is just “common sense.”

### AN EXPERIENTIAL LEARNING EXAMPLE

Operations management is one subject where many students encounter the threshold concept of business being just “common sense.” This is potentially based on the fact that most students have worked in some area where operations management was present but was taken for granted. To help students overcome this threshold concept, we developed a semester-long operations management project where students apply operations management concepts. The course has been taught each summer semester beginning in 2009. The primary objective of the course is to have students learn operations management by preparing to open a hypothetical pizza restaurant.

We originally designed the course for online graduate students and have altered it for use in face-to-face classes. It could also be easily adapted to undergraduate students. Other courses could also benefit from the concept based case construction design, such as courses in strategy, human resource management, and marketing, to name a few. Students work independently on assignments and do their own research and make their own decisions, although we do encourage students to discuss issues and ideas in the instructor-monitored discussion forum. The typical class size is usually less than 30 students; with grading and discussion monitoring assistance, the class size could be larger. There are eight assignments (see Appendix A). In 8-week sessions, an assignment is due each week. For long-semester sessions, an assignment is due every other week. Students are required to review previous assignments and make changes to their strategy and plans as they become more familiar with operations management concepts.

We used the Wolfe and Byrne (1975) experiential learning structure (design, conduct, evaluation, and feedback) to guide the student through the discovery that operations management is a practice that is built on substantial theory and research.

#### Design

The overall learning objective of this course is to assure a conceptual understanding of operations management as a component of organizational strategy and competitiveness.

Second-order objectives are for students to operationalize theories and methods in operations planning, resource management, inventory control, quality systems and manufacturing. At the end of the course, students should be able to analyze, interpret, and apply operations management practices, including the management of process and production systems, service delivery, and global supply chains. What we have found in the past is that many students engage in surface learning of these objectives because they do not realize that their level of “common sense” is not adequate.

The design selected is a concept-based case construction through guided assignments. This design provides an experiential learning experience that encourages active involvement, engages student creativity, and allows for social learning (Philips, 1995). The experience was the simulated planning of a pizza production and delivery operation. Guided assignments lead the students through iterative phases of production planning, inventory systems, quality control, operations strategy, process layout, and other operations concepts. Students are encouraged to share ideas, challenges, and solutions through an instructor-monitored discussion board.

Pizza production and delivery was selected for several reasons. Students are well acquainted with the overall process of production and delivery, but do not know the theory that supports these processes. Students therefore are forced to expose their threshold concept of “business as common sense” and form new conceptions using a familiar process, but with a new language of operations management and the theories needed to explain the cause-and-effect processes that are present. Students expand their learning by visiting and watching pizza operations, interviewing pizza operations managers, and investigating pizza

franchise websites to help explain the things that they thought they once understood.

### Conduct

In this phase, the instructor introduces students to operations management practices. The goal of each assignment is to place the student in the role of the operations manager, thereby causing the student to solve real problems. In the first assignment students are asked to define the pizza production and delivery process. Students often see this task as trivial and use common words to refer to their experiences in pizza restaurants. Common responses are very short and refer to taking orders, making pizzas, and delivering them to the customer. Table 1 shows that this type of response is typical of students who are in the preliminal phase. These students are still at the threshold where operations management is still “just common sense.” During this stage students are encouraged to discuss their pizza operations project with other classmates using discussion boards. This social learning process allows students the opportunity to see what other students are saying about their projects. Some students will make comments like “I didn’t realize all of the steps involved in making a pizza” or “It took me three pages to discuss the pizza-making process.” Comments like these cause the students in the preliminal phase to go back and review their answers. They ask themselves, “Is my level of understanding deep enough?” Students begin to see themselves as operations managers and they become more engaged with the material.

Students may struggle at first with guided experiential assignments since they are a new process of learning. Therefore, students may need more support early in the process. The

TABLE 1  
Indicators of liminality stages for threshold concept—“Management as common sense”

Assignment content	Preliminal	Liminal	Postliminal
Overall assignment	Completed from personal perspective	Personal perspective supported by text book reference	Theory is integrated into decisions about the project
Language/word choice	Common words	Language of the discipline	More complex language of the discipline
Ideas	Refer to previous experience	Link previous experience with text book ideas	Integrate previous ideas to demonstrate how they changed their thinking
Discussion with other students	State their own experiences. No questioning of others.	Begin to integrate other student comments with their own experiences	Offer recommended changes to demonstrate why something occurred
Level of discussion	Fact or event level	Begin to incorporate cause and effect discussion	Explain why something occurred and the theory behind the event
Use of concepts	Refer to concepts with limited understanding	Discuss concepts at a more abstract level	Integrate multiple concepts and view the concepts through the eyes of the discipline

instructor is reminded that the student can be struggling with both process and knowledge during this phase. Students must become familiar with the process before conceptual knowledge can be obtained. Wright and Gilmore (2012) suggest that at this stage students may be at a preliminal stage and will need guidance and coaxing as they approach the liminal threshold. As they gain experience and confidence their work generally improves until at some point they move forward to the postliminal stage. One student put it this way: "I was very overwhelmed during the first few weeks, but then got the hang of everything after that. I'm a person that enjoys lots of structure, so this class was a great learning opportunity for me, in that I don't really need as much guidance as I thought I did." (J. C., personal communication, August 25, 2009).

We have found that conducting an experiential exercise with multiple guided assignments that build on each other fosters deeper thinking and creativity than one large experiential exercise. This scaffolding allows the student to use language of the discipline repetitively, thereby increasing the likelihood they will remember it. Similarly, students are given the opportunity to review their previous work and uncover their own naivety in their role of an operations manager. Students also take on roles of mentor and mentee in group discussion, where they seek the advice of other students to help them learn the theories that help support their positions. Students begin to focus on concepts related to assignments and text readings, rather than taking a surface learning approach, because they know that the next assignment will further expose their lack of understanding if they just try to "fake it" in the near term.

## Evaluation

Using experiential learning exercises requires time and attention from the educator. Students always seem to learn something new, take a turn the educator never expected, and sometimes outpace even the educator. The use of experiential learning exercises to uncover threshold concepts is equally challenging since the educator has to evaluate where each student is in the liminality process. We found instructor engagement in the discussion is best applied through reading posts and assignments and then asking probing questions to ensure students understand the underlying concepts. This encourages students to think more deeply about concepts and helps them see how to apply the concept to their pizza operations project.

When students jump to conclusions without considering options, we ask probing questions to guide the students to consider more options: "What else would work?" "Have you considered how the problem is solved in other industries?" "What would customer reaction be to this suggestion?" If an idea is generated without connections to theory or research, we may encourage students to provide more connections: "What support do you have for this idea?" "Is there a theory that would explain why your actions might work?" If students make decisions that may prove to be challenging or impractical, such as purchasing only local produce, we guide students in their

thinking: "What would the supply chain look like to accomplish that objective?" "What products will be produced in the off seasons?" The question pushes the students to go beyond their current liminal and to consider what might exist beyond the threshold.

We have also found that students will put more time and energy into learning the concepts if their grade is based on conceptual understanding. Therefore, we grade assignments using a rubric that considers conceptual understanding and application (see Appendix B). The rubric simplifies the grading process, allows for specific instructor comments, and provides the student with a clear understanding of expectations. The syllabus provides additional structure by informing students that each subsequent assignment will be an improvement on the previous work.

Evaluation of a student's conceptual level is more complicated. Since almost any concept could be a threshold concept for a given student, it is up to the instructor to look for clues to misconceptions of preliminal/liminal/postliminal behavior. Table 1 exhibits typical student behaviors associated with many facets of the assignment across the three liminality stages. For example, for a student in the preliminal stage of the threshold concept, management is practice informed by theory, and the student will rely heavily on personal experience and perspective in preparing the assignment. Encouraging students to use, define, and apply operations management terms/concepts helps students move to the liminal stage. As the students strive to meet the instructor's expectations, they gradually move to the postliminal stage where they use theory to support the decisions they make in the assignments.

## Feedback

Student feedback should begin early in the process and should be consistent throughout the course. In this example, students receive feedback from the instructor, people interviewed in the process, and classmates. Because assignments build upon one another, students see weaknesses in previous work as they move forward in the course. Students post comments and questions to an online discussion board, where they receive feedback from classmates. The instructor monitors discussions to ensure that student feedback is accurate and dispels misinformation.

The evaluation process provides the foundation to help students and instructor recognize where students are getting stuck in a preliminal state (Meyer & Land, 2003). The instructor's role is to be aware and react to the stuck condition and guide the student past the threshold to a postliminal state. Guidance through probing questions helps the students construct the knowledge themselves.

The instructor's role is to provide guidance and feedback to help bring out the creativity needed in an experiential learning exercise. Encouraging students to visit a pizza operation to observe and interview operations managers often encourages performance and learning.

## IMPLEMENTATION AND LESSONS LEARNED

Threshold concepts by their nature are difficult for students to conquer, since they are counterintuitive, alien, or incoherent (Perkins, 1999, 2006). We found that designing an operations management course using experiential learning exercises created the perfect environment to move the student from preliminal to liminal, and finally to a postliminal stage of the conception that operations management is practice supported by theory. In this section we combine Wolfe and Byrne's (1975) guide for using experiential learning to address threshold concepts with lessons we learned during the implementation process.

In the preliminal stage, the student holds on to previous knowledge (Meyer & Land, 2003) and may not be ready to grasp the new knowledge. All four experiential learning phases (Wolfe & Byrne, 1975) address the student in this stage. When the instructor chooses to use an experiential learning exercise, the instructor should commit to designing a learning experience that moves the student past the preliminal stage. As the instructor conducts the course, he or she sets the learning stage and then monitors the student's level of understanding so the instructor can adjust the process or extend the time to allow the student to make sense of the base knowledge. During the conduct phase, the instructor determines whether the student is still in the preliminal stage or whether the student is ready to move forward. The key to this step is the evaluation of the student by the instructor and the student's response to instructor feedback. Again, the focus is on determining whether the student understands the base material and seeing whether the student is ready to be advanced into the liminal stage.

Assignment 1 requires students to define the pizza production and delivery process. Many of our students demonstrated they were in the preliminal stage as witnessed by the lack of understanding about the complexity and nested nature of production processes. Students who initially completed tasks without reading the book chapters found that their "common sense" was not enough to explain what they were seeing. Students posted comments to the discussion board and received peer and instructor feedback that allowed them to realize that deeper learning was necessary.

As the students pass into the liminal stage they hold on to previous knowledge while they make sense of the new knowledge. Threshold concepts create situations where the student must wrestle with new, conflicting, or other troublesome ideas. In assignment 2, students had to further refine their pizza operation and develop an operations strategy. Students were often surprised by the depth of planning and complexity involved in a pizza production and delivery operation. From their experience it looked like a very simple process. One student observed, "Working on this project made me think about restaurant operations in ways that I had never previously considered. I found myself noticing bottlenecks when sitting in restaurants" (M. S., personal communication, August 5, 2012).

Using experiential learning exercises helps instructors facilitate the student's learning in this phase. The instructor conducts the exercise to expose the new idea and then gives feedback and works with the student to "listen for understanding" (Land et al., 2005). At this point the instructor can provide the feedback and probing questions needed to challenge the student's old understanding and new understanding. This forces the student to evaluate his or her old knowledge. Wright and Gilmore (2012, p. 625) claim that "if the coaxing is done successfully then the preliminal student becomes confused and frustrated." At this point the student is entering the liminal stage. We found that having assignments that required students to adjust previously completed assignments provided the perfect scenario of providing feedback and expecting more developed ideas. Students began to develop a greater appreciation for the knowledge and theory in the book and how it could be used to explain what they were seeing and thinking.

As the student continues to struggle, he or she holds on to his or her previous conceptions and begins to embrace the threshold concept. If the instructor continues to conduct the experiential exercise in a manner that allows the student time to evaluate his or her knowledge and then gives the student feedback, this helps the student regard his or her emerging understanding of the threshold concept and encourages the student to tolerate the uncertainty (Wright & Gilmore, 2012). We found that this process is facilitated by pacing the guided assignments over the semester by altering the time for instruction, receiving or sending rich feedback to the student, and encouraging the student to evaluate old knowledge and new knowledge.

### Effect of Implementation on Learning

Phillips (1995) claims that threshold concepts can be taught using active, social, and creative learning. The results of using the experiential learning structure to address the "common sense" threshold conception shows that we are able to use all three learning styles as we move students through the liminality stages.

Active learning is facilitated through the design and conduct of the experiential learning exercise. The definition of experiential learning states that active participation by the student leads to learning. When instructors choose to use experiential learning, they commit to using the active learning approach to teaching. This design further supports active learning when the instructor conducts the exercise. This phase allows the instructor to ensure that all students are engaged, cognitively, physically, or emotionally. One student summarized this point: "The pizza process was a great part of the course. It forced me to apply the concepts of the book to the real world. I now understand why so many businesses fail. Opening and running a business is not easy by any means" (A. W., personal communication, August 10, 2010)

Social learning is also enhanced by using experiential learning. The major social groups associated with experiential

TABLE 2  
Percentage of students in each liminality stage based on student initiated discussions

	Liminality stage	Assignment							Total
		2	3	4	5	6	7	8	
Initial post	Preliminal	86.7%	85.7%	72.7%	61.5%	75.0%	30.8%	23.1%	62.6%
	Liminal	13.3%	14.3%	27.3%	30.8%	25.0%	53.8%	61.5%	31.9%
	Postliminal	0.0%	0.0%	0.0%	7.7%	0.0%	15.4%	15.4%	5.5%
	<i>n</i>	15	14	11	13	12	13	13	91
Subsequent posts	Preliminal	50.0%	57.9%	33.3%	42.1%	11.1%	20.7%	15.0%	37.5%
	Liminal	48.0%	42.1%	44.4%	42.1%	66.7%	48.3%	35.0%	46.4%
	Postliminal	2.0%	0.0%	22.2%	15.8%	22.2%	31.0%	50.0%	16.1%
	<i>n</i>	50	38	18	19	18	29	20	192

learning are shown in the student-to-student interactions, student-to-instructor communication, and student to pizza operations manager interaction. The design of this experiential learning exercise creates circumstances when the student must talk with other people. The student hears multiple viewpoints. In the discussion board, students discuss their ideas, and create new ideas. This social interaction allows the student to determine whether the new knowledge is both accurate and useful, thereby creating a situation where the student can release his or her old knowledge (Meyer & Land, 2005) and embrace the new knowledge. Few curriculum delivery models allow such interaction between students and instructors, and among students.

Creative learning has long been described as both a contribution and challenge with experiential learning. As discussed in the social learning section, the students created new knowledge as they combined their knowledge with peer knowledge and instructor knowledge. Creative learning is so prevalent in experiential learning that many have warned that the student often learns something that was not foreseen by the instructor (Gentry, Commuri, Burns, & Dickinson, 1998). Threshold concepts offer real learning opportunities for students. However, as the student steps through the door to new knowledge, that student may create other knowledge by using a focal lens that others have not used before.

As seen by this discussion, the four phases of experiential learning (Wolfe & Byrne, 1975) allow for the active, social, and creative learning that Phillips (1995) says are important for overcoming troublesome knowledge. The use of experiential learning helped us expose student misconceptions and allowed us to guide the students through the threshold concept liminality stages.

### Evidence of Learning

We have argued that students encounter threshold concepts and that experiential learning exercises will allow students to

progress through the liminality stages. We have also claimed that discussion, either between students or between student and instructor, will lead to social learning that may benefit student progress in overcoming threshold concepts. To evaluate these claims, we reviewed each of the discussion posts made by a section of students enrolled in an operations management class and evaluated the students' level of liminality using the indicators of liminality stages provided in Table 1. Each discussion post was evaluated first by whether it was initiated by a student (Table 2) or by the instructor (Table 3). We discuss each along with our findings.

Students were required to initiate at least one discussion for each assignment, starting with assignment 2, using a Web-based discussion forum. Students could choose any topic in the chapter, but they had to provide enough information to encourage other students to respond to their post. Students were required to read all discussion posts and to respond to posts, if they wanted. Table 2 shows the percentage of students by liminality stage for initial posts and subsequent posts for assignments 2 through 8. Subsequent posts are posts by other students or by the student that initiated the post. Table 2 reveals three important events. First, students increased their liminality over the eight assignments. Discussion posts on assignment 2 showed that 86.7% of the posts reflected preliminal thought. Conversely, by assignment 8 only 23.1% of posts demonstrated preliminal thought. This is important since new concepts were introduced each week, thereby potentially creating new threshold concepts for students. Second, subsequent posts showed increased liminality over initial posts. The average of all seven posts shows that 62.6% of all initial posts reflected preliminal thought, as opposed to only 37.5% for subsequent posts. Students seem to help guide each other through the liminality stages, thereby supporting the idea that social learning would help with threshold concepts. Third, increased liminality was evidenced in subsequent posts across the course. As the course progressed, students seem to have gotten better at challenging their understanding, which led to increased liminality.

TABLE 3  
Percentage of students in each liminality stage based on instructor questions/discussion

	Liminality stage	Assignment							Total
		2	3	4	5	6	7	8	
Initial post	Preliminal	83.3%	77.8%	83.3%	87.5%	40.0%	57.1%	85.7%	75.9%
	Liminal	16.7%	22.2%	16.7%	12.5%	60.0%	28.6%	14.3%	22.2%
	Postliminal	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%	1.9%
	<i>n</i>	6	9	12	8	5	7	7	54
Subsequent posts	Preliminal	33.3%	26.7%	28.6%	18.2%	7.7%	20.0%	11.8%	20.2%
	Liminal	44.4%	46.7%	42.9%	36.4%	69.2%	40.0%	47.1%	46.8%
	Postliminal	22.2%	26.7%	28.6%	45.5%	23.1%	40.0%	41.2%	33.0%
	<i>n</i>	9	15	14	11	13	15	17	94

It was also argued that delivering information using an experiential learning exercise based on the Wolfe and Byrne (1975) structure of designing, conducting, evaluating, and giving feedback would help expose threshold concepts and encourage migration through the liminality stages. Throughout the course the instructor monitored the student discussion board and posted to the discussion when students seemed to be struggling with a threshold concept or if misconceptions seemed to be perpetuating. These posts were traditionally in the form of questions, or clarifying comments (see Appendix A for more detail on typical instructor evaluation and feedback comments). Table 3 shows the percentage of students by level of liminality from student initial posts and the level of liminality demonstrated by students after the instructor's post. Results from Table 3 show that the level of student liminality increased after the instructor's discussion. The average of assignments 2 through 8 showed that 75.9% of the students were in the preterminal stage before the instructor comments, but only 20.2% of them remained at that level after the discussion.

A second observation is that students appeared to respond better to the instructor's posts as the course progressed. Assignment 2 shows that student posts that occurred after the instructor's post still had 33.3% of the students in the preterminal phase. However, only 11.8% of the students remained at this level in assignment 8. A final observation comes from comparing student initiated posts (Table 2) and instructor led posts (Table 3). Instructor-led posts appear to be more effective at guiding students toward liminal or postliminal thought. The average number of student-initiated subsequent posts shows 37.5% of the students remained in the preterminal stage and that only 16.1% reached a postliminal stage of thinking. In comparison, student discussion based on instructor-led discussion had only 20.2% of students continuing in preterminal thoughts, while one-third (33.0%) of the students actually achieved postliminal thoughts. Based on these observations, we propose that using experiential learning does help students overcome threshold concepts.

## CONCLUSION

Each student is on a learning journey built around mastery of previous concepts, threshold concepts, and threshold conceptions. The starting point and endpoint of this journey will vary for each student (Wright & Gilmore, 2012). This places great pressure on educators to identify threshold concepts, teach at the conceptual level, and allow students to wrestle with the new knowledge. Similarly, educators must create situations to deliberately listen to the student and determine moments where the student is "stuck." At these moments the educator must allow the student to actively engage the new knowledge and to create or recreate knowledge either alone or socially in an active manner. In this way the educator allows the student to uncover new knowledge, thereby mastering the threshold concepts and threshold conceptions.

The primary purpose of this article was to show how experiential learning could be used to overcome the threshold concept that operations management is "common sense." Using the four-phase experiential learning structure (Wolfe & Byrne, 1975) we developed a series of assignments that provided the necessary structure to lead the student through the preterminal, liminal, and postliminal stages associated with the importance of theory in management practice. In the development and use of this structure we were able to encourage active, social, and creative learning that undoubtedly helped students master the threshold concept.

An additional benefit of this project is the acknowledgment that students need time to overcome threshold concepts. Therefore, identifying and developing curriculum to systematically expose and overcome threshold concepts is important. Some students will undoubtedly identify and overcome threshold concepts by themselves. However, others may never step through the door to a new way of thinking. Business schools should therefore identify at least one management introductory course and guide students through the discovery that management is not just "common sense." Students must rigorously engage and challenge current management theory to be

successful in management practice. Students who go through this threshold early in their management education will be able to transform the way that they approach every management class taken from that point on. This single step may challenge the observation that management and business education is too easy by developing students who are more willing to engage theory in the development of their business practice.

## REFERENCES

- Burch, G. F., Burch, J. J., Bradley, T. P., & Heller, N. A. (2014). Identifying and overcoming threshold concepts and conceptions introducing a conception-focused curriculum to course design. *Journal of Management Education*. Advance online publication. doi:10.1177/1052562914562961
- Davies, P., & Mangan, J. (2006). Embedding threshold concepts: From theory to pedagogical principles of learning activities. In R. Land, J. H. F. Meyer, & J. Smith (Eds.), *Threshold concepts within the disciplines* (pp. 37–50). Rotterdam, The Netherlands: Sense Publishers.
- Gentry, J. W. (1990). *What is experiential learning? Guide to business gaming and experiential learning*. London, UK: Nichols/GP Publishing.
- Gentry, J. W., Commuri, S. R., Burns, A. C., & Dickinson, J. R. (1998). The second component in experiential learning: A look back at how ABSEL has handled the conceptual and operational definitions of learning. *Developments in Business Simulation and Experiential Learning*, 25, 62–68.
- Hoover, J. D., & Whitehead, C. J. (1975). An experiential-cognitive methodology in the first course in management: Some preliminary results. In R. Buskirk (Ed.), *Simulation games and experiential learning in action: Proceedings of the Second National ABSEL Conference*. Bloomington Indiana, 9–11 April 1975. Austin, TX: University of Texas.
- Irvine, N., & Carmichael, P. (2009). Threshold concepts: A point of focus for practitioner research. *Active Learning in Higher Education*, 10, 103–119.
- Land, R., Cousin, G., Meyer, J. H. F., & Davis, P. (2005). Threshold concepts and troublesome knowledge (3): Implications for course design and evaluation. In C. Rust (Ed.), *Improving student learning diversity and inclusivity* (pp. 53–63). Oxford, UK: Oxford Centre for Staff Learning and Development.
- Meyer, J. H. F., & Land, R. (2003). *Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practicing within the disciplines* (ETL Project: Occasional Report 4). Edinburgh, UK: University of Edinburgh.
- Meyer, J. H. F., & Land, R. (2005). Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. *Higher Education*, 49, 373–388.
- Perkins, D. (1999). The many faces of constructivism. *Educational Leadership*, 57, 6–11.
- Perkins, D. (2006). Constructivism and troublesome knowledge. In J. H. F. Meyer & R. Land (Eds.), *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge* (pp. 33–47). London, UK: Routledge.
- Phillips, D. C. (1995). The good, the bad, and the ugly: The many faces of constructivism. *Educational Researcher*, 24, 5–12.
- Polya, G. (1954). *Mathematics and plausible reasoning* (2 vols.). Princeton, NJ: Princeton University Press.
- Polya, G. (1957). *How to solve it: A new aspect of mathematical method* (2nd ed). Garden City, NY: Doubleday.
- Ramsden, P. (2003). *Learning to teach in higher education*. London, UK: Routledge Falmer.
- Scheja, M., & Pettersson, K. (2010). Transformation and contextualization: Conceptualizing students' conceptual understandings of threshold concepts in calculus. *Higher Education*, 59, 221–241.
- Walsh, A., & Borkowski, S. C. (2014). Linking teams with technology: Integrating databases in experiential exercises in an introductory business course. *Organization Management Journal*, 11, 243–257.
- Whetten, D. A. (2007). Principles of effective course design: What I wish I had known about learning-centered teaching 30 years ago. *Journal of Management Education*, 31, 339–357.
- Wolfe, D. E., & Byrne, E. T. (1975). Research on experiential learning: Enhancing the process. *Business Games and Experiential Learning in Action*, 2, 325–336.
- Wright, A. L., & Gilmore, A. (2012). Threshold concepts and conceptions: Student learning in introductory management courses. *Journal of Management Education*, 36, 614–635.

## APPENDIX A: GUIDED ASSIGNMENTS

### Assignment 1: Define the Pizza Production and Delivery Process

**Design**—The objective of this assignment is to make students apply operation management concepts to a real scenario. Students accomplish this by describing their fictitious pizza restaurant. In this first assignment, students are introduced to the following concepts:

**Processes:** delivery processes, production processes, ordering processes, nested processes.

**Costs:** fixed costs, variable costs, break-even analysis.

**Assumptions:** making assumptions, justifying assumptions.

**Conduct** (The following information is given to the student.)

In this module you will begin to develop your Pizza Production and Delivery Operations project. Your first task is to define the processes and nested processes for order taking, production, and delivery. You will also begin to make assumptions about costs and decide whether it is best to make the pizza crust or to buy it.

You will have to make assumptions about your process since you were not given any data. This may be new to you but have no fear. What you assume is not as important as how you deal with the assumptions you make. However, you should provide support for why you believe your assumption is correct. You should base your assumptions upon research, observation, simulation or calculation. Be sure to explain how you reached your assumption and provide references and citations for any information you use from another source.

My expectation is that you will use the learning from this module to apply the terminology and concepts to the assignment and that your work will be of professional quality. Consider you are writing these assignments as reports to a client, investor or a CEO.

Questions:

1. Describe the pizza order taking, production and delivery processes and nested processes.
2. What costs are involved in making and delivering a pizza? Make a list of the fixed and variable costs involved. It is not necessary to estimate the actual dollar amounts.
3. Use break even analysis from your text and calculate whether it would be best to make the pizza crust or to buy the crust ready to use. Make whatever assumptions necessary to support our decision. Provide justification for your assumptions.

**Evaluation**—Students are beginning to settle in to the class, so very little evaluation is needed at this time. This is a good time to talk to students about operations management being the practice of theory and the importance of applying theory to their projects to make them more efficient and more profitable.

*Feedback*—Students will most likely still be concerned with completing assignments so that they can achieve the grade that they desire. Students are looking for feedback on how to be successful in the class. Reinforce the need to apply theory to their projects.

### Assignment 2: Further Define the Operation and Begin Planning

*Design*—The objective of this assignment is to make students develop their operations strategy statement and to consider how they will run a successful business. The pizza restaurant is becoming a real business in some students' minds. However, many students still consider this assignment to be trivial. After all, how hard can it be to run a pizza restaurant? Students are introduced to the following concepts:

Processes: core processes, critical path.

Competencies: core competencies, competition, competitive advantage.

Market: market segment.

Students are introduced to Pert and Gantt charts.

*Conduct* (The following information is given to the student.)

Develop your operations strategy. Ask yourself some important questions about the pizza production and delivery market. What would give your operation a strategic competitive advantage? Some corporate level strategies include low cost provider, best value, focused differentiation, or broad differentiation. You might want to consider one of these as the starting point for your operations strategy. The operations strategy should describe HOW you will accomplish the corporate strategy including the type of products and services offered as well as identifying the customers.

Your operations strategy should develop and change as your learning of operations management increases. Also the strategy should be the foundation for decisions you will make later on. For these reasons you MUST revise your operations strategy and place it at the top of each future assignment.

Another important activity in this module is to develop a project plan. Consider you are going to open a new facility for pizza production and delivery. Your task is to develop a plan for opening that facility. You will need to make assumptions about space requirements and location. You will also have to decide whether to lease or build. What equipment will you need? What kind of work force is needed and what training will the workforce need? Use the Gantt or Pert chart tools as described in the textbook. A simple Gantt or Pert chart can be made using Microsoft Excel or Word.

Remember to use the Pizza Project Discussion to get help from your classmates. Someone probably has experience or learning from previous course work that may be helpful. If you do use someone else's ideas (even from the discussion page) be sure to give them credit through citations and references.

Investors are waiting for your report. My expectation is that you will use the learning from this module to apply the terminology and concepts to the assignment and that your work will be of professional quality. Consider you are writing these assignments as reports to a client or a CEO.

Questions:

1. Prepare an operations strategy statement that will guide you through the rest of this project. Consider how you will use

operations to gain a competitive advantage, what products and services you will provide, and to whom. Answering the following questions may help better define your strategy.

2. Make a list of the core processes required to operate a successful pizza delivery operation.
3. What core competencies are necessary to support those core processes.
4. What market segments would your operation serve (list as many as you can think of)? What strategies will you need to serve these markets?
5. Prepare a Pert or Gantt chart for equipping, staffing, and opening your pizza delivery operation. Include the critical path. Some questions you might want to consider are location, rent or build, type of equipment, workforce, training, and so on. Be sure to identify the critical path.

*Evaluation*—Students are beginning to integrate information from the lecture, book, and discussion. Find ways to get students to engage in discussion in class or online through discussion boards. Begin listening for common use of words and personal experiences that indicate preliminary thought patterns. An example is "I have to say in my experience, this is a process that many do not use." Students who are entering the liminal stage may respond with "I have never had to create a network diagram until our assignment and did not realize how time-consuming, or how useful, they can be." Students who are at the postliminal stage are at the point where they can take the new knowledge and make abstractions like "We use processes every day without really thinking about them, yet they create order in our lives." A second consideration is that any concept can be a threshold concept. Continue to listen for the "common sense" threshold, but also think about the new concepts being introduced.

*Feedback*—Allow discussion to progress with students long enough to allow students to redirect themselves, but not so long that they create misconceptions. Interject thought-provoking questions to get students to reconsider their comments. Using the preliminary comment from earlier, "I have to say in my experience, this is a process that many do not use," the instructor could ask "What do you use?" "How does that work for you?" "Is there a better way to do that?" "What would be the harm in trying this process to compare it to what you have seen?" The goal is to get the student to let go of their current knowledge/experience and start grabbing hold of the new information.

### Assignment 3: Prepare Your Process Strategy, Process Flow, and Performance Measures

*Design*—Starting with this assignment, students must integrate their existing knowledge and new knowledge. Students developed their initial operations strategy statement in assignment 2 with very little operations management theory, and much more "common sense." Students should start to see that their level of knowledge was insufficient to develop a strong operations strategy. As students patch holes in their original strategies they should see that other elements are being affected, and

therefore will alter them as well. Students are introduced to the following concepts:

Processes: flow charting.

Performance: measurement, metrics.

Inventory: inventory strategy.

Students are introduced to flow charting.

*Conduct* (The following information is given to the student.)

Your operations strategy will become the foundation of the process strategy you will select for your pizza production and delivery operation. Review the various production models and determine which model will best fit your strategic plan. Be sure to justify which model or combination of models you selected. Use this model to set up your production methods. You will develop a flow chart that shows the entire process from taking the customer's order through production to delivery of the product.

Once the process has been designed it becomes necessary to control that process. Controls depend upon measures and it is up to you to determine what you will measure. One little axiom you may want to keep in mind: "Measures drive performance." If this is true then what you measure will be what employees concentrate on. Be sure you are measuring the right thing. Let me give you an example from my experience.

A company I worked for measured production output every day. In fact, the output measure was shown on an electronic sign in the middle of the plant. Output became the most important objective in the minds of the production workers. However, the company had a strategic focus on quality. Quality measures were visible only in reports that were distributed to managers, so quality did not seem as important an output to the production people who were responsible to make quality happen.

My expectation is that you will use the learning from this module to apply the terminology and concepts to the assignment and that your work will be of professional quality. Consider that you are writing these assignments as reports to a client or a CEO.

Questions:

1. Further develop your operations strategy by including a summary of your process strategy and be sure to include it at the top of this assignment.
2. Prepare your production process and inventory strategy. You may use a model from your text or develop a hybrid strategy. Remember strategy is an overview of the operation, you will get into detail next.
3. Develop a flow chart of the process from order taking through production to delivery.
4. Identify what performance measures you will use to evaluate the process described above and how you would make the measurements.

*Evaluation*—Students should now be comfortable integrating information from the lecture, book, and discussion. Continue to listen for indications of preliminal thought and surface learning. "I think flow charts are useful," or "I have used flow charts in the past." You should see that more students are developing liminal and postliminal thoughts. A favorite example came from a male student who said, "I wish I could use this idea to help me with my baby." In the next class period the student discussed how his wife, mother-in-law, sister-in-law, and he had made a flow chart for him to use when the newborn baby

got fussy. He said that he used it every day to determine how to soothe the baby.

*Feedback*—Students should be getting and giving feedback freely at this point. Continue to allow discussion to progress with students long enough to allow students to redirect themselves, but not so long that they create misconceptions. At this point students need to consider how adjustments they are making in one area affect other areas. Consider questions like "What affect will this have on your delivery process?" or "What will this do to the market segment you have chosen?"

#### **Assignment 4: Prepare a Quality Plan for the Pizza Operation and Consider Process Constraints**

*Design*—Students continue integrating existing knowledge with the concepts of quality and variation. Major areas of integration come from the introduction of theory of constraints where students see that profits can be increased by improving processes. This integration causes students to consider their knowledge about metrics, inventory control, quality control, and utilization of resources. Students are introduced to the following concepts:

Processes: Theory of constraints.

Variation: common causes, assignable causes.

Performance: quality, quality control.

Inventory: inventory strategy.

Students are introduced to constraint management (theory of constraints) and quality management.

*Conduct* (The following information is given to the student.)

If quality is difficult to define, where do we start? You should not be surprised to learn you should start with your business and operational strategy. For example, the definition of quality for a low-cost provider, like Timex, would be quite different from a focused-differentiation provider like Rolex. The next place to look to define quality is the customer. What does the customer want? Before you can answer this question you must know your customer (review your Market Analysis).

Once you know what quality is, you must find a way to be sure it is maintained for each customer. Your quality plan will look at the product and service provided and determine sources of variation. Then you will find ways to eliminate, reduce, or control those sources of variation.

There is also variation in how materials flow through a process this variation can cause bottlenecks, where material backs up and restricts the output of the process. Managing bottlenecks is called the theory of constraints. We will explore ways to manage bottlenecks and plan how best to keep production flowing with a bottleneck in the pizza production and delivery operation

Questions:

1. Further develop and revise your operations strategy based upon leaning from this module and be sure to include it at the top of this assignment. (Think of the strategy as an executive summary of all your work so far.)
2. List the features of the product and service that are important to the customer's perception of quality.
3. List the common and assignable causes of variation for these features.

4. Explain how best to assure each of the above features meet or exceed customer expectations. You might try inspection, process control, eliminate variation, or some other quality control tool. Explain which works best for each case and why.
5. Assume the oven is the constraint during periods of peak demand. How can you use theory of constraints to best deal with the limited oven capacity?

*Evaluation*—Students need to be reminded at this point that they need to support their ideas with the theories from the book. Students should now be using the language of operations management. Listen for incorrect use of words and terms. Words like “constraints,” “bottlenecks,” “quality,” “measurement,” “metrics,” and so on will often be misused. Students are less likely to correct this misuse of terms, so it becomes imperative for the educator to evaluate students. Incorrect use of words and terms could be a simple vocabulary issue or a sign of misconceptions. Only through careful evaluation will an educator know the difference and be able to apply appropriate corrective measures. Pay particular attention to student’s liminality stages for assignable causes and common causes. Student often struggle with these concepts.

*Feedback*—Use similes and metaphors to help students overcome threshold concepts like assignable causes and common causes. Ask: “What is this like?” “How is this different from?” “Can you give me an example?” Present the student with a nonexample and see if the student can recognize that this is incorrect. For example: “It is common for workers to call in sick on Monday if a major sporting event is televised on Sunday. Therefore, this is an example of a common cause.” The student should recognize that this is an example of an assignable cause since it can specifically be identified. Students will struggle with the word “common” and need to have this specifically pointed out.

### Assignment 5: Prepare a Process Layout for Variable Volume Production

*Design*—This assignment helps draw many of the previous assignments back together. Students will revisit assumptions, production plans, their operations strategy, product variation, and productivity. Students are introduced to the following concepts:

Processes: theory of constraints.

Variation: production variation.

Performance: lean systems, capability.

Students are introduced to lean systems and mapping production layout.

*Conduct* (The following information is given to the student.)

The next step in the pizza production and delivery operation is to define the process plan. The production plan must support the strategy and the quality plan. Thus, the production plan must be integrated into the overall business strategy and plan. Begin with the process layout. How will the pizzas be made? Be sure to consider the variation in demand. The process must be flexible enough

to be efficient at both high and low volumes (review production efficiency).

Once a process layout is designed, the improvement process begins. As you study lean systems, think about the operations you have developed so far. Could they be improved? The answer is, yes. Consider what improvements you could make and how these improvements would impact the process efficiency.

Questions:

1. Further develop your operations strategy based upon learning from this module and be sure to include it at the top of this assignment.
2. Discuss the layout you think is best for your pizza production and delivery operation. You should look over your strategy and process plan as you begin this task. It will be necessary to make assumptions about volume and to estimate production capability. Provide support for your assumptions.
3. Draw the process layout (floor plan), showing the approximate locations of work stations and equipment for order taking, production, and delivery processes. Indicate material flow with arrows.
4. Explain how you can maintain productivity when production volumes vary with low volumes in mid afternoon and late evening and high volumes at noon and early evening.
5. Evaluate your entire process plan so far from a lean systems perspective. What improvements could you make? Calculate the improvement in productivity if all the improvements were made.

*Evaluation*—Students encounter several new words that they have rarely used in the continuous improvement and quality management assignment. Threshold concepts often occur with words like “kaizen,” “kanban,” “poka-yoke,” “takt time,” and others. Conversely, students who have used only one continuous improvement or quality management system may believe that their method, and words, are the only correct ones to use. Discuss the similarity and differences of each program so that students can make broad generalizations to form accurate concepts based on the way the program defines, measures, analyzes, improves, and controls their improvements.

*Feedback*—Continue to use similes and metaphors to help students see how one system is similar to and different from another. Emphasis should be placed on students understanding concepts, but students should still be familiar with terms used specifically by each continuous improvement program. Students will exhibit considerable surface learning behaviors with these new terms. This is evidenced by the relatively few follow-on discussions that are initiated by students if the original discussion uses these unfamiliar terms. Try to initiate feedback from students by asking, “Can you remind the other students what ‘heijunka’ means?” or “Can you give an example of ‘single-digit setup’?”

### Assignment 6: Plan for Value Chain Management and Select an Operation Location

*Design*—This assignment unveils the importance of supply chain management on business success. At this point, students understand processes, but they need to focus on how specific processes will affect their business performance and how some

companies have used supply chain management to create a competitive advantage. Students are introduced to the following concepts:

Processes: supply chain design, supply chain integration, production inventory, production ingredients.

Location: dominant factors, secondary factors, site-specific factors.

Performance: facility maintenance.

Students are introduced to facility location analysis.

*Conduct* (The following information is given to the student.)

Consider the materials required to operate a pizza production and delivery operation. Certainly you need all the pizza ingredients but what else do you need? Will you need cleaning materials, promotional items, order pads, pizza cutters? Can you think of anything else?

Where will you get these items? Well, yes, I suppose you could get them from Wal-Mart but is that the best way to manage your supply chain?

Location is another important consideration in any supply chain. Consider how location can impact your operational strategy. Is it best to be located close to suppliers or customers or both?

Questions:

1. Revise your operations strategy based upon learning from this module and be sure to include it at the top of this assignment.
2. What items will be purchased to support your pizza production and delivery operation? Think beyond just ingredients to pizza. What materials will be needed to support production, order taking, delivery, and facility maintenance?
3. Describe a supply chain that would give your pizza production and delivery operation a competitive advantage over your competitors.
4. What factors must be considered when selecting the location for the pizza production and delivery operation? Identify the dominant and secondary factors. Then describe the ideal location.

*Evaluation*—Students have usually considered many of the concepts in this assignment and may migrate back to using their previous knowledge instead of integrating new knowledge. Listen for common words and redirect student efforts to include analysis of dominant factors in manufacturing and service. An example of a preliminal statement made by one student was, “I know we can all relate to the critical mass strategy when shopping at the mall . . . this increases competition between stores in the vicinity of the mall.”

*Feedback*—Students may need to be refocused during this assignment. The preliminal statement just described showed that the student was not considering location selection in his or her conception of critical mass. The educator needs to redirect the student to the task by asking, “Why would you consider opening a pizza restaurant next door to another restaurant?” “Why do some companies choose their locations in close proximity to their competitors?” “How does this choice of direct competition in close proximity with competitors affect your operations strategy?”

## Assignment 7: Develop an Inventory Control Plan to Manage Various Types of Inventory

*Design*—This assignment extends the supply chain management discussion by introducing inventory control plans and forecasting techniques. The depth of this lesson is important to consider, since entire courses can be designed around this subject. Students need to understand the concepts of inventory management and forecasting. It is important to provide the student with enough information and tools to allow them to uncover the concepts without making them experts at forecasting techniques. Students are introduced to the following concepts:

Processes: inventory segmentation, forecasting.

Forecasting: demand, lead time, lot size, inventory cycles, reorder point.

Performance: forecast accuracy metrics, service level requirements.

Students are introduced to forecasting techniques.

*Conduct* (The following information is given to the student.)

Inventory can be a considerable expense for many operations. Losses due to obsolescence, spoilage, and theft can reduce profitability. A strong inventory management system can be another possible competitive advantage. In this module you will categorize inventory so that each category can be managed in such a way as to assure sufficient material to prevent stock outs while not incurring excessive carrying costs. Use ABC Analysis for categorizing the inventory.

Your inventory control plan would be much better if you knew how many pizzas were going to be ordered each day. Although we cannot predict the future, we can develop a forecast based upon the past. Forecasts help operations managers make decisions that will keep their operations efficient and with sufficient resources.

Questions:

1. Revise your operations strategy based upon learning from this module and be sure to include it at the top of this assignment.
2. Identify and categorize all of the inventory items needed to support the pizza productions and delivery operation.
3. Develop an inventory control plan for each category.
4. Explain what data you will need and how you will use it to develop forecasts for inventory and resource management.
5. How can a good forecast make your operation more efficient?

*Evaluation*—This assignment is usually the most challenging for students that have weaker math backgrounds. These students need to be guided towards conceptual understandings. Student discussion will be dominated by students with higher math skills. Engage students who usually contribute but who are quiet during this assignment. These students will need to be encouraged to discuss at the concept level. The interaction of concept-level discussion and mathematical procedure discussion will help all students.

*Feedback*—Students may need encouragement to discuss this topic. The educator should listen to students and guide them toward conceptual understanding. Students who say “We chose a weighted moving average to solve the problem” could be asked “Why do you choose that method?” or “What are the advantages of weighted moving average?” or “What demand

signals made you think that weighted moving average is appropriate?" Students need to understand the concepts of supply, demand, and cost. Providing the right item, to the right place, at the right time, and for the right price is imperative for forecasting. The methods we use to accomplish this are not as important.

### Assignment 8: Prepare a Sales and Resource Plan

*Design*—This assignment builds on the inventory control and forecasting discussion to ensure future demands can be met through operations planning and scheduling. This assignment allows students to integrate their knowledge about operations, accounting, materials, distribution, and marketing through the discussion of a sales and operations plan. Student are introduced to the following concepts:

Processes: material requirements planning (MRP).

Forecasting: dependent demand, end item, parent products, components, bill of material.

Performance: action notice.

Students are introduced to material requirements planning (MRP).

*Conduct* (The following information is given to the student.)

We have looked at several elements of operations management separately. It is now time to put them back together into an operational system. There are several tools that could be used to manage sales and operational resources. In this assignment we will use MRP as our primary tool. As you explore the resource management tools, consider what inputs are needed and what outputs are provided to help manage your operation.

I hope you enjoyed this exercise in developing a pizza production and delivery operation. It was designed to give you a taste of operations management. It is a broad field with many areas of specialization.

Questions:

1. Revise your operations strategy based upon learning from this module and be sure to include it at the top of this assignment.
2. Explain how MRP can be used in your pizza production and delivery operation to balance resources and forecasted demand.
3. Based upon the process you have developed and assumptions of pizza demand, develop a scheduling system to be sure there are sufficient production and delivery personnel available to meet demand.
4. What area of operations management did you find most interesting for a possible career?

*Evaluation*—This assignment allows students to integrate components from each of the previous seven assignments. Listen to students to ensure integration is occurring. Many students will focus heavily on developing an MRP in Excel and miss the opportunity to connect learning with inventory planning, forecasting, constraint management, operations strategy, and other components. Students may still struggle with the new concepts that have been introduced. A typical threshold concept for students is dependent demand.

*Feedback*—Students will need to be encouraged in this assignment to use this information to make their final adjustments to their operational strategies. Help students realize that operations management is not just "common sense." Students should be asked, "How has your operations strategy changed since assignment 2?" "What was the biggest change to your strategy?" "Why did you modify your strategy?" "How does that modification apply to your current job, or previous job?" "How could you use this learning to help a hotel become more efficient?" The feedback given to the students therefore becomes confirmation that they have learned at the concept level and that they can apply this new knowledge to other working environments.

## APPENDIX B: GRADING RUBRIC

Criteria	Exceptional	Very good	Good	Needs improvement	Below expectations	Poor performance
Key terms and concepts are used and defined	10 Points Detailed definitions of key terms and concepts.	9 Points	8 Points Good definition of applicable terms.	7 Points	6 Points Definitions missing or incorrect.	5 Points
Key terms and concepts are applied to a pizza production operation	10 Points Very detailed description of application of terms and concepts.	9 Points	8 Points Demonstrates understanding of terms and concepts by application.	7 Points	6 Points Application of terms and concepts missing or incorrect.	5 Points
Spelling and grammar	5 Points No errors found.	4 Points	3 Points Few errors found.	2 Points	1 Points Several errors found.	0 Points
Creativity	10 Points Creative and innovative operations solutions.	9 Points	8 Points Some creativity indicated.	7 Points	6 Points Little creative thinking.	5 Points
All questions completely and correctly answered	15 Points Well-reasoned and articulated answers.	13 Points	11 Points Answers are mostly complete and correct.	9 Points	7 Points Incomplete or wrong answers.	5 Points

Instructor Feedback:

---

## ABOUT THE AUTHORS

**Thomas P. Bradley** is an associate professor and COBA Graduate Program Director at Tarleton State University. He earned his PhD from University of North Texas. His research interests are in the area of management learning and education. He can be reached at [tbradley@tarleton.edu](mailto:tbradley@tarleton.edu).

**Gerald F. Burch** is an assistant professor of management at Tarleton State University. He received his PhD in management/organization behavior from Virginia Commonwealth University. His primary research interests

are student engagement, effects of experiential learning, and the neurological learning process. He can be reached at [gburch@tarleton.edu](mailto:gburch@tarleton.edu).

**Jana J. Burch** is an independent educational consultant and has taught for the University of Virginia and the University of Connecticut Neag School Of Education. Her research interests are individual and team creativity, curriculum design and the learning process. She can be reached at [jana@davincistudies.com](mailto:jana@davincistudies.com).