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Teaching Tip

Teaching Business Process Concepts in an Introductory Information Systems Class: A Multi-Level Game-Based Learning Approach

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ABSTRACT

This research develops an effective methodology for a core business introductory information systems course to teach business process concepts and the role of information systems in business processes. The developed methodology also helps students properly diagram an organization's business processes. The methodology uses an experiential learning approach: Multi-dimensional Game-based Learning. Initially, students learn elementary business processes and modeling concepts, e.g., start, end, activity, and gateway. Advancing to a more complex process during the second level, student teams learn the concept of process activity responsibility, e.g., role, pool. The last level challenges student teams to manage a company in a simulated business environment using an SAP® Enterprise Resource Planning system. Students learn the relationship between information systems and business processes and the concepts of data flow, encapsulation, event, and parallelism. A survey of the student's perception and the researchers' ad hoc observations demonstrates the effectiveness of the developed methodology.

Keywords: Business processes, Business modeling, Game-based learning, Teaching tip

1. INTRODUCTION

A *business process* (BP) is "any set of activities performed by a business that is initiated by an event, transforms information, materials or business commitments, and produces an output of value to the organization or stakeholders of the process" (*Business Process*, 2013); *business process modeling* is the creation of a representation of a BP. Process models describe a BP and provide a basis for its improvement. Generally, it is helpful to model BPs' flow and feedback loops to understand how an organization accomplishes its work and justify a process' products (Harmon, 2019). Therefore, by learning to model a BP, students develop skills that enable identifying the role of an organization's components (including information systems), establishing the value of component-level products, and understanding the organization's use of resources, including people and information systems (IS). Since organizations are exponentially using IS, BP modeling skills are essential for workers and IS students.

Since 2000, the Association for Computing Machinery and the Association for Information Systems (ACM/AIS) IS curriculum have included *BP* and *BP modeling* as essential

skills. Since a BP can encompass activities and resources throughout an organization, the BP curriculum is multi-disciplinary, i.e., to gain skills related to BP concepts necessitates understanding concepts from disciplines outside of IS. Further, an organization can be considered a system (Harmon, 2019), which is a teleological, holistic collection of components, i.e., it produces a product or service that is more than the constituent components produce (Farkas, 2017). Thus viewed, each IS is one of an organization's collection of components. Therefore, an IS cannot be taught in isolation; a multi-disciplinary curriculum is necessary.

Irrespective of the ACM/AIS Model IS curriculum, business education is characterized as 1) relying on an inflexible functional teaching focus, 2) lacking a cross-functional process and integrated business perspective, and 3) having an undue focus on Information Technology (IT) skills rather than using IS and IT (Seethamraju, 2012). Further, the traditional approach to teaching IS, e.g., lectures, textbook reading, and testing, is unidisciplinary; it explores IS concepts in isolation from other disciplines, ignoring the increasing organizational use of IS with other components. A growing research corpus supports the ACM/AIS multi-disciplinary

approach (e.g., Blaylock et al., 2009; Çeviker-Çınar et al., 2017; Ducoffe et al., 2006; Nisula & Pekkola, 2018;). The Association to Advance Collegiate Schools of Business's Assurance of Learning standards noted and incorporated the need to integrate business knowledge across functional disciplines (AACSB, 2020).

The authors' College of Business undergraduate core curriculum has an introductory IS course with three learning objectives related to BP concepts; a three-game experiential multi-leveled learning activity has been designed for these learning objectives. At first, students play a candy inspection game; they learn to understand and describe the essential components of a BP and basic BP modeling skills (e.g., activity, start, stop, gateway). Next, students play a role-based card sorting game, which adds advanced BP concepts and associated BP modeling techniques (e.g., pools, roles). Finally, students are placed into teams that run a company in a simulated environment using an SAP® Enterprise Resource Planning (ERP) simulation game. Students build on the concepts discovered in the first two games; they learn how BPs are related, and the role of an IS in a BP. The framework of this experiential multiple-level game-based learning approach is described in Section 3, Experiential Learning Framework.

This research seeks an effective teaching methodology through which students learn the role of an IS in BP. Such a methodology shall result in students being able to 1) define BP concepts, 2) explain a BP to business stakeholders, and 3) describe the role of IS in BP, e.g., ERP.

The following section contains a literature review. The next section discusses the experiential learning framework providing the background (including the learning objectives) and classroom exercises (the games). After that, we provide evidence of the method's effectiveness. We conclude with a discussion.

2. LITERATURE REVIEW

Business schools have traditionally approached a multi-discipline pedagogic design using capstone projects, integrated case studies, team teaching, and simulation games (Nisula & Pekkola, 2018). For example, capstone projects require students to develop and implement a business plan by assuming a team's functional area role. Simulation games assign students to cross-functional teams that interact within an artificial dynamic business environment that provides simulated responses to students' decisions. However, these strategies' effectiveness was not empirically measured nor widely known (Chance et al., 2007). Ducoffe et al. (2006) found that the more integrated an interdisciplinary, team-taught course, the more positively students evaluated it; however, they raised concerns regarding the benefits received versus the higher cost. Nevertheless, these approaches do not provide insight into how IS and IT can be managed or used to support a BP (Seethamraju, 2012). One approach used successfully by business schools is ERP simulation games, which impart an understanding of BPs in a vibrant and stimulating learning environment (see Léger, 2006; Seethamraju, 2011).

Typical hands-on ERP experiential approaches have been widely used to teach BPs. Rienzo and Han (2011) observed that students could not recognize BP components. However, the students believed they had improved their BP knowledge, which the researchers attribute to the students' "awareness of

the greater complexity businesses face when dealing with purchasing and sales compared with consumers" (Rienzo & Han, 2011, p. 197). This finding was consistent with previous ERP and science education studies: hands-on, step-by-step assignments produced an appreciation for complexity; however, it did not produce a comprehensive understanding of BP concepts (e.g., Davis & Comeau, 2004; De Bruin & Rosemann, 2006; Graziano, 2003; Hofstein & Lunetta, 1982, 2004; Nelson & Millet, 2001). Rienzo and Han (2011, p. 197) also posited that "game simulations could improve active engagement," while Monk and Lycett (2016) demonstrated that students need basic business knowledge before learning BPs from a simulation. However, Shen et al. (2015) demonstrated that using a role-playing exercise before a simulation game resulted in a significant increase in "student knowledge of the three key business processes and ERP system's role in supporting business processes significantly," which is a two-level experiential game.

The literature has shown that active learning is more effective than traditional lectures to achieve a wide range of desirable educational outcomes (e.g., Freeman, 2003; Freeman et al., 2014; Prince & Felder, 2007). Researchers have investigated various active learning approaches: cooperative learning, discussions and debates, peer teaching, and game-based learning (e.g., Bonwell & Eison, 1991; Tharayil et al., 2018). Game-based learning (GBL) incorporates educational content or learning designs into games. Like other active learning approaches, GBL exercises encourage student participation and interaction with their instructor and peers, which provides students with experiences in interpersonal communication, teamwork, group problem solving, and debating from differing perspectives. GBL encompasses fun, play, engagement, serious learning, and interactive entertainment (Ahmed & Sutton, 2017). It has been widely used in higher education to inspire students to learn and apply theoretical concepts and knowledge in hypothetical or real-life business cases. IS education studies have shown the practicality of GBL methods (e.g., Liu et al., 2020; Troussas et al., 2020). GBL sustains engagement, improves performance, and promotes a transformational mindset and creative thinking.

Gamification and simulation are the essential GBL methods. Gamification supports various activities and behaviors by adapting familiar game experiences (Majuri et al., 2018), i.e., gamification integrates game theory and design, game elements, game esthetics, and game mechanics into the learning experience. A serious game is one in which education rather than entertainment is the primary goal (Michael & Chen, 2005; Wilkinson, 2016; Zyda, 2005). A simulation is the imitation of reality in which an alternative reality is created within a controlled environment; it narrows the focus of serious gaming.

Researchers have investigated the efficacy of gamification and simulation to learning BP concepts (e.g., Alcivar & Abad, 2016; Léger, 2006; Shen et al., 2015). However, as Rienzo and Han (2011) demonstrated, a simulation is insufficient for students to learn these concepts. Therefore, we utilize a multi-level game-based learning approach (ML-GBL); it helps students meet the learning objectives by gradually grasping concepts and practices.

3. EXPERIENTIAL LEARNING FRAMEWORK

3.1 Background

The researcher’s college requires all majors to take the introductory IS course to learn how organizations use BPs and how an IS is related to BPs. Originally, business process concepts were taught using a textbook chapter on BPs, the related online Learning Management System (LMS) simulation, discussion questions, chapter quizzes, and two in-classroom exercises. While this pedagogic method provided an understanding of the BPs, the students’ diagrams and question responses demonstrated a limited understanding of the underlying concepts. Though the textbook and LMS provide some insight into the relationship between an IS and BPs, the relationship was not evident in the exercises. The exercises did not contain an IS. Finally, a language of BPs was not provided in the exercises, i.e., neither the LMS nor the exercises exposed students to a process design methodology.

3.2 Improved Classroom Exercises

Because of the identified pedagogic gaps, a new teaching methodology was developed that met the college’s Learning Objectives for the course (see Table 1).

	Learning Objective
1	Students will describe the essential components of a BP accurately, e.g., activity, role, task.
2	Students will demonstrate the effective communication of a BP to stakeholders
3	Students will explain the relationship of an IS to an ERP business process

Table 1. Learning Objectives

The new pedagogic method uses the international standard in BP modeling, BP Modeling Notation 2.0 (BPMN). The BPMN standard encompasses the notation and semantics of collaboration, process, and choreography diagrams in a standardized notation that provides a process designer a means to communicate a BP with business users, technical implementers, customers, and suppliers (OMG, 2014). Using BPMN as the pedagogic method’s foundation, the exercises teach students the mechanics of BP modeling. Also, students learn the components of a business process, critical and creative thinking skills associated with BPs, and a means to communicate with various stakeholders effectively.

The developed methodology consists of four classroom exercises that begin with a simple process and culminate with an ERP simulation. These exercises introduce the students to an increasingly complex process concept and require students to create an appropriate BPMN diagram drawn using Cawemo® (<https://cawemo.com/>), a free online collaborative BPMN diagramming tool. Each exercise is summarized in the Appendix and described in the following sections.

3.2.1 Simple Inspection Process. The first exercise has the students perform and diagram a simple candy inspection. The exercise begins the students’ mastery of Learning Objectives 1 and 2 (see Table 1). The instructor introduces the concept of a BP (a collection of activities and decisions that achieve a purpose). Experience with classes has shown that the instructor should explain the highest-level concepts (e.g., what is a BP and

activity) and enable the students to discover the essence of BP concepts through the exercises.

After the briefing, the instructor distributes bags of M&Ms candy to ad hoc groups of students (groups should be one or two students; however, the exercise has worked with three students). Intentionally, the instructor provides the teams with vague instructions: determine the number of defective candies in the bag. The instructions must not define what constitutes a defective candy; permit the class to discover a variety of meanings to defective, which is essential for Learning Objective 2. In keeping the instructions vague, students will be forced to decide what the assignment means and discover the variety of ways that simple instructions are interpreted.

Once all teams have completed the candy inspection (usually under five minutes), the instructor directs them to create their Cawemo® account to draw the diagrams.

Prior to the class, the instructor should create a Cawemo® project, open the project, expand the collaborators’ panel, and add each student as a collaborator (20 student emails can be entered at a time). Students receive an email invitation to join the project. On joining the project, Cawemo® directs the students to create their accounts, and the instructor can have access to student drawings created in the project. Our experience is that this preparation requires no more than 15 minutes for a class of 30 students.

Initiating the students learning of Objectives 1 and 2, the instructor facilitates a ten to fifteen-minute discussion on how they inspected the candy. Initially, the instructor should poll the class to elicit each group’s defect criteria and the number of defects they found. Notably, the instructor should lead the class to understand the differences in how each group interpreted the instruction to determine that an M&M was defective, which helps explain the need that descriptions be specific, i.e., include sufficient details within a process diagram.

The instructor begins a thirty to forty-five-minute guided discovery of the inspection process and explanation of the BPMN start (circle), path (arrow), activity (rectangle), and gateway (diamond) symbols and directs the students to create a new diagram. This diagram should be kept simple; therefore, it should only use the start, activity (a sub-activity with an annotation can be introduced for the inspection process), exclusive gateway, and stop symbols. Pools and lanes will be introduced in the next exercise.

Once the students identify either the inspection activities or the check for another candy activity, the instructor discusses the concept of a BPMN exclusive gateway. The instructor emphasizes that each exit pathway has an appropriate, exclusive business rule label, i.e., only one pathway from the gateway can be followed.

While the class interactively designed an inspection process, the instructor emphasized that the diagram was one of many possible designs (see Figure 1); an appropriate process diagram communicates clearly to the intended audience.

Each student is encouraged to submit a design for the inspection process they used. The guidelines for the student’s diagram are detailed in the Grading Rubric Activities, Gateways, and Process sections of the Appendix. Because the instructor guides the students, the diagram has the lowest overall grade (see the Grading Rubric Section of the Appendix). The Activity and Gateway criteria are equally weighted (essential concepts), and the Process criterion has a lower weight (see the Appendix).

Throughout this simple, familiar activity, students are introduced to foundational BP concepts, e.g., activity, gateway, business rule. Also, the exercise challenges students to use critical thinking skills to analyze their inspection process to find these foundational BP concepts. Lastly, students learn to communicate their BP by drawing a BPMN diagram, which enables them to learn the meaning (i.e., the BP concept) and use of basic BPMN symbols.

3.2.2 Simple Role-Based Process. The second exercise expands the students' mastery of Learning Objectives 1 and 2 by introducing the vital BP concept of a role. A BP role handles designated activities and tasks, i.e., a task is performed by the role to which it is assigned. Importantly, resources (e.g., a staff member, an IS) are not assigned to a task; instead, a resource is assigned to a role; a resource obtains responsibility for tasks from this assignment.

The second exercise uses a simple process, sorting a deck of cards into suits. However, unlike the first exercise, team members are assigned a specific responsibility (dealer or suit specialist) and can only perform tasks assigned to that responsibility. Dealers can select a card from the unsorted deck, determine the card's suit, and provide it to the appropriate suit specialist when the specialist is available. Suit specialists can only receive a card of their assigned suit and then place it in the correct order in the suit's sorted stack.

In this exercise, students use the BPMN symbols previously learned and include pools and lanes, which segregate the BPMN symbols by responsibility (role). Students sort the cards twice during the exercise to understand the concept of a role: first without role assignments, then with the assigned roles. As discussed later, the instructor should enable the students to discover the value of process roles through the sorting processes' differences.

The instructor then introduces the BPMN 2.0 concepts of a pool and lanes (a simplistic approach is to consider a pool as a collection of roles responsible for performing the activities of a process and that a pool's lanes represent the roles). Two important concepts related to the use of pools and lanes are that

- activities belong in the lane responsible for performing the activity, and
- the process must have at least one start and one end within the pool (otherwise, it is not complete).

The instructor may explain that a diagram can include more pools. However, this is a complex concept that the exercise does not need. Students are asked to create a BPMN diagram of the card sort process (see Figure 2) that meets the Grading Rubric criteria BPMN Rules, Roles, and Process of Appendix. The Roles and Process criteria are equally weighted (new concepts), and the BPMN Rules criterion has a higher weight (see the Appendix). Because the instructor guides the students, the diagram has a lower overall grade (see the Grading Rubric Section of the Appendix).

In practice, we lead the class by creating a diagram to show students how to work with a pool, add lanes, label lanes, and place symbols within the appropriate lane. In addition, this is an opportunity to discuss BP diagramming best practices that improve the comprehensibility of the diagram; these best practices include:

1. avoid crossing paths,
2. label all BPMN symbols (see Figure 3),
3. create a symmetrical grid for the entire diagram in which symbols are placed, and
4. keep symbols the same size, eliminating unintended meanings such as relative time to complete or relative importance.

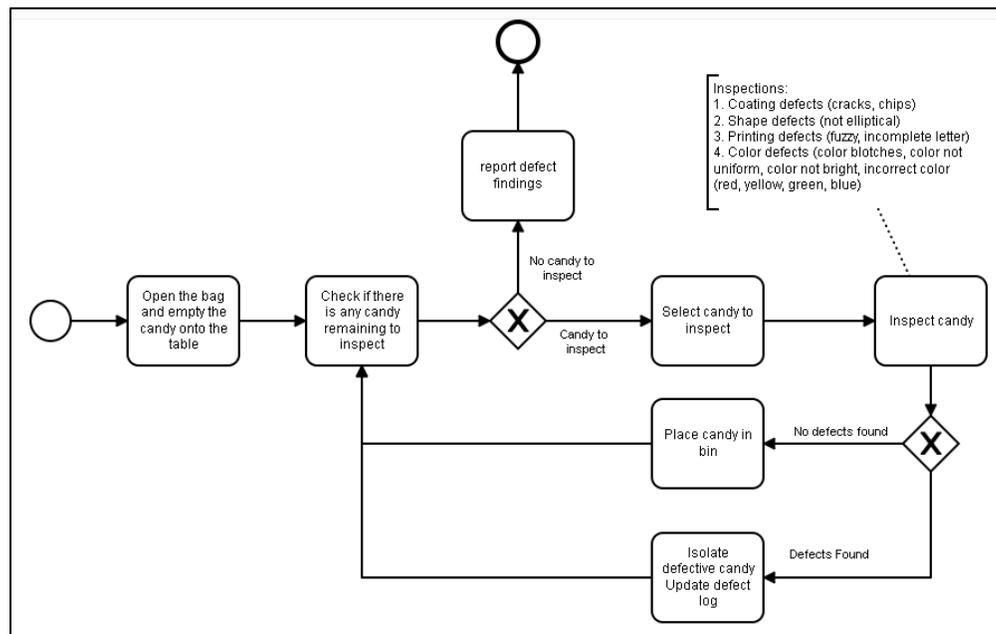


Figure 1. Sample Inspection BPMN Diagram

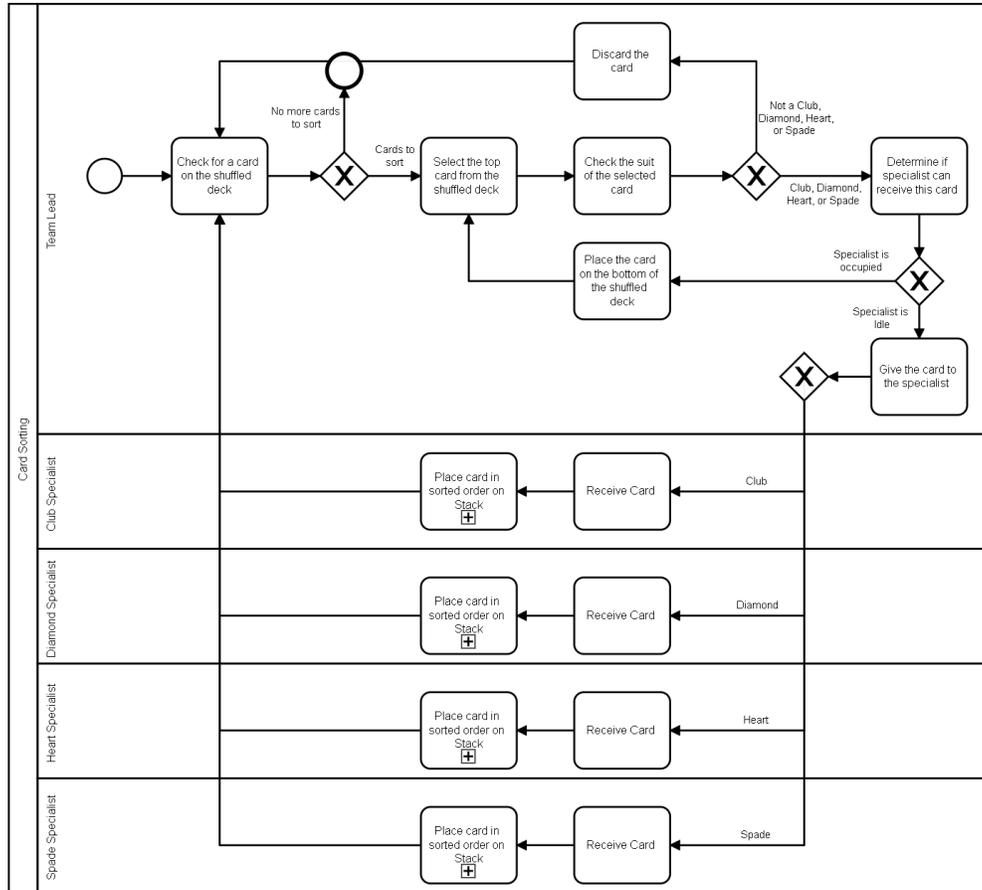


Figure 2. Sample Card Sort BPMN Diagram

Throughout this card sorting exercise, the foundational BP concepts are reinforced. The instructor introduces the concept that a role instead of an individual is associated with an activity. Assigning responsibilities to a role reveals the relationship between an IS and BP (and SAP® to the BP in the last exercise). The exercise uses a more complex BP to develop students' critical thinking skills to identify its components. Finally, students enhance their learnings to communicate a BP using BPMN. The exercise challenges the students to communicate each role's responsibilities. Also, due to the increased complexity of the business process, students make choices in organizing their diagrams so that stakeholders can understand the process. These skills prepare the students for the next exercise, where they must determine roles and design a complex business process.

3.2.3 Dependent Discrete Processes. This exercise reinforces Learning Objectives 1 and 2 by emphasizing skills from the prior exercises and introduces Learning Objective 3 (see Table 1). The earlier exercises focused on simplistic BPs that needed a limited number of resources. This exercise introduces the complexity that is commonplace in BPs: a process that is a collection of associated processes that are not necessarily a sequence that progresses from one process to the next, and certain resources are restricted to a specific process and, in

many instances, such resources are provided by the predecessor process.

The third exercise prepares students for the final exercise; its objective is to transform the concept of a gateway from a decision to a path selector and demonstrate the relationship of an IS to a business process. As mentioned in Exercise 1, a BPMN gateway was incorrectly described as being analogous to a decision. This exercise substitutes that easier analogy with making a BPMN gateway analogous to a traffic circle, which is the correct BP concept, i.e., a vehicle enters with a travel itinerary; then selects the exit based on the information in the itinerary. Finally, this exercise has the students include a simple IS, Excel®, within their BP for record-keeping.

The exercise uses the simulated business exercise that consists of two processes: product design and product manufacturing. Teams are instructed to design and manufacture a gift candy product using the materials provided (approximately 15 minutes). Preparation for this exercise can take time to gather the candy and craft materials (see the Materials section of the Appendix for suggestions). However, once the teams complete manufacturing the product (about 30 to 45 minutes), the instructor discusses the difference between the design and manufacturing processes (about 15 minutes). The design process is indeterminant, e.g., unknown task order, frequency, and resources (see Figure 4). Conversely, a manufacturing process is determinant, e.g., known task order,

frequency, and resources (see Figure 5). The design process requires sophisticated BPMN concepts appropriate for a higher-level course.

The next step is to introduce the idea that processes and process diagrams are extensible and reusable, i.e., the new product does not need a dedicated process; instead, the existing process can be slightly altered to accommodate the new product. The instructor explains that the teams are to manufacture a second product, which must be distinctive from the first product. It must be manufactured concurrently with the first product, and it must use as many existing process activities as possible.

The high-level diagram aims to enable all team members to understand their sub-process' dependencies, i.e., the predecessor activity that must be completed to initiate their activities and the successor activity dependent on the completion of their activities. Having the team collaborate on the high-level diagram and each team member completing the details within their assigned lane accomplishes two purposes.

First, it provides students with the collaborative use of an IS (Cawemo®), which is different from social collaboration with which they are familiar. Second, it prevents students from building a creative, unrelated diagram for their activities; therefore, the lane must have both the role and the assigned student's name. Finally, the instructor must emphasize that each student is only responsible for their role.

Once complete (about 45 minutes), the instructor asks each team member to enhance their team's high-level process diagram with sufficient details for the concurrent product manufacturing for their role (see Figure 6). The detail is sufficient when someone from another team could perform the team member's role using the diagram.

The BPMN diagram needs to meet the Grading Rubric criteria BPMN Rules and Process in the Appendix. Because the instructor provides limited guidance, the diagram has a higher overall grade (see the Grading Rubric Section of the Appendix); the Process criterion has a higher weight (see the Appendix).

BPMN	Symbol	Label Best Practice	Example
Activity		Object + Verb	Receive Payment
End		Process' end state	Payment information complete
Event		Object + Past Participle	Order checked-out
Gateway		Question; out-going paths with answer (condition)	Is payment information complete?
Lane		Role's name	Customer
Pool		Name of Resource Group or Process	Online ordering
Start		Object + Past Participle	Order started

Figure 3. BPMN Symbols

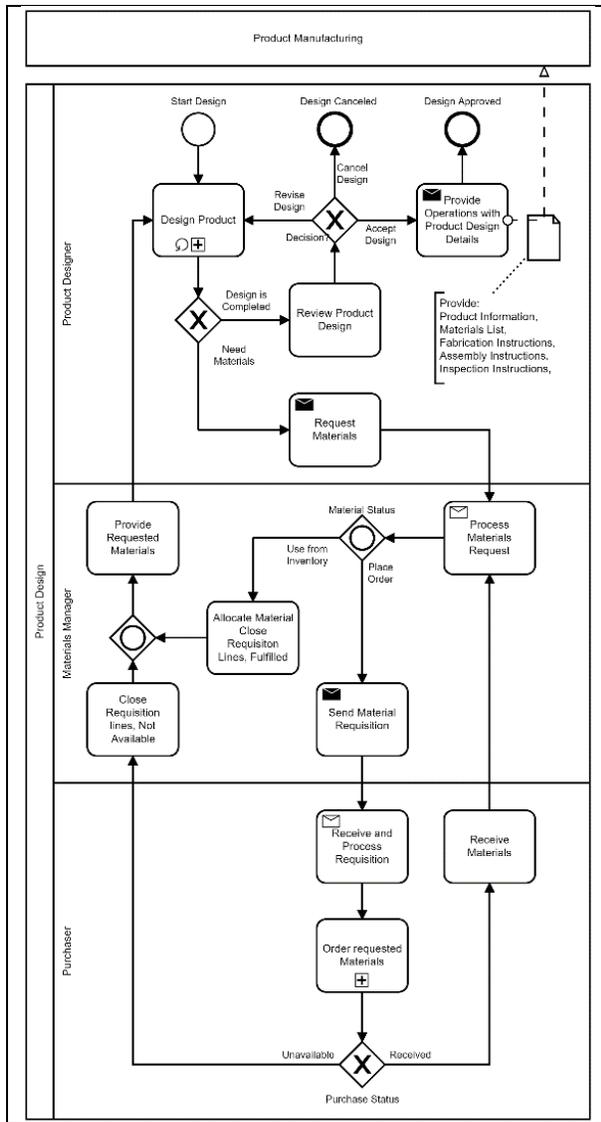


Figure 4. Sample Design Product BPMN Diagram

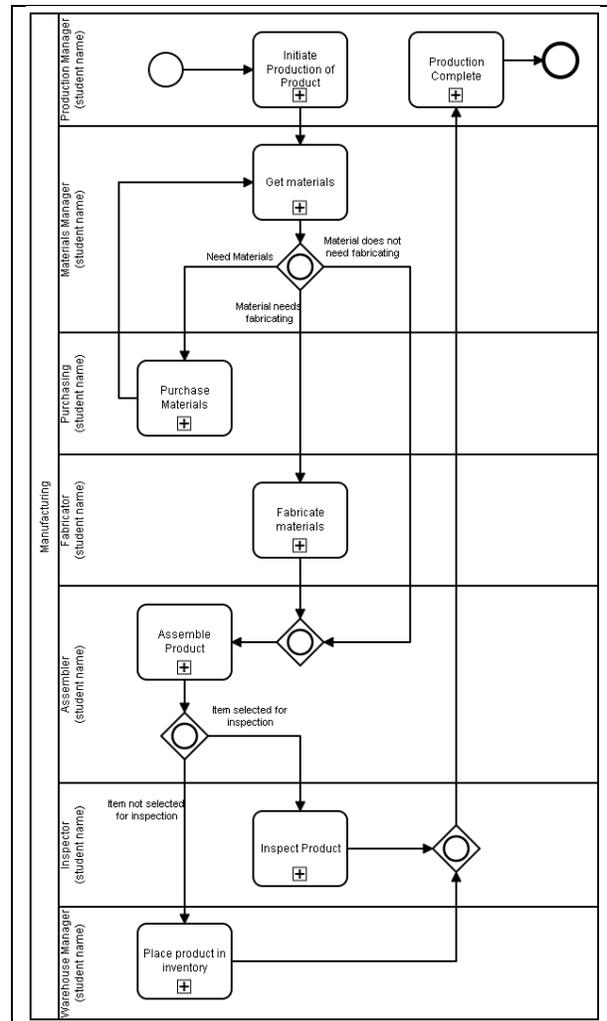


Figure 5. Sample High-Level Product Manufacturing BPMN Diagram

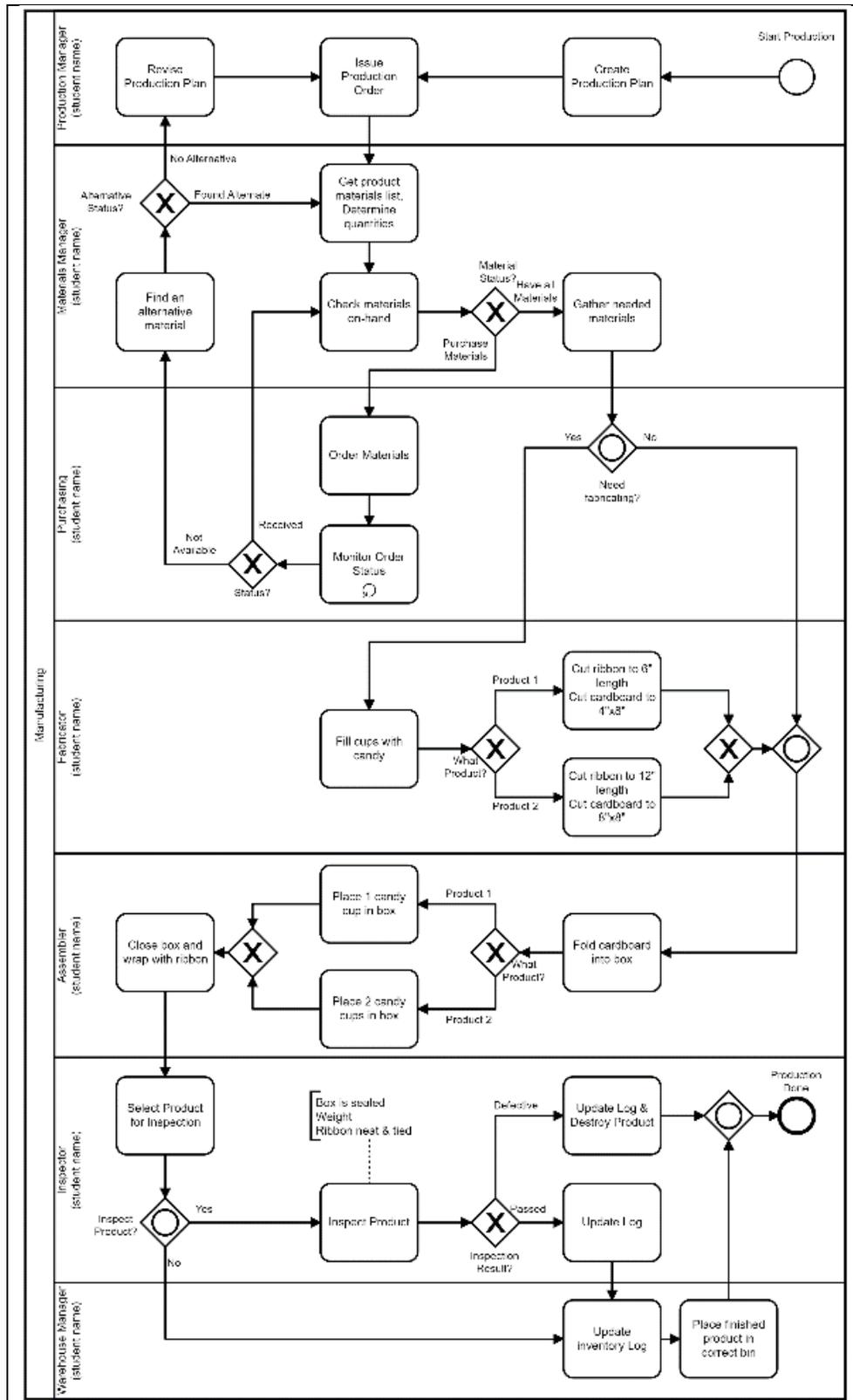


Figure 6. Sample Detailed Product Manufacturing BPMN Diagram

This lead-up exercise has re-enforced the foundational BP concepts, enabled students to communicate a complex BP using the BPMN notation, and introduced the relationship of an IS to a BP. The pedagogical approach for these exercises has been to provide students with guidelines from which they developed and then documented the BP. Each exercise introduced complexity to the process and reduced the guidance to the students, which reinforces Learning Objectives 1 and 2. In addition, the pedagogy developed critical and creative thinking skills, which are the foundation for how BPs are identified and documented in the workplace. These skills are necessary for the final exercise: students will need to identify the BP obscured by the exercise's focus on using an IS, SAP®, in a simulated multi-business environment

3.2.4 Complex Business Process with an Information System. This final exercise aims for the mastery of Learning Objectives 1 and 2 and reinforcing Learning Objective 3 (see Table 1). Pedagogically, this exercise is different from the others: 1) students are provided information on the simulation; however, differing from the previous exercises, students are not provided the BP description (they are provided with the information on the use of the IS), and 2) students are provided training on how to work with the simulated environment.

Pedagogically, the exercise incorporates an ERP simulation game, which traditionally is used to achieve supply chain-related learning objectives (Léger et al., 2010) and has been demonstrated to teach graduate students a process orientation and an integrated view of business (Seethamraju, 2011). The simulated environment immerses students in the operations of a for-profit company whose processes are dependent on an IS. Their experience is like a real-world company in which a new employee is taught how to use the computer to do a task, not necessarily to understand its context. Further, by selecting a pedagogic tool intended for learning how to use an IS, students are challenged to observe beyond the steps of tasks. Students are asked to identify the BP and its use of the IS, i.e., students are challenged to use critical thinking skills to see beyond the steps of the exercise and identify the business context of the simulation.

By immersing the students in a simulated ERP business environment, this final exercise presents students with a real-world challenge to identify and communicate the current business process. Further, students are introduced to the basics of systems thinking to analyze and describe BPs (an in-depth study of systems thinking is left for an upper-level course). The ERP simulation requires two 2-hour sessions: training and the competitive game. At the start of the first session, the class is divided into two-member teams (the simulation can work with single-member teams and, if necessary, a three-member team). Students are instructed to log into the simulated environment

(using the browser-based GUI, this setup takes about 20 minutes and enables the simulation to be run remotely; using the app on students' computers takes 45 minutes). Once all students are in the simulated environment, the instructor explains that each team runs a water bottle distribution company that uses an SAP® ERP system. The instructor explains that all teams sell the same products to the same customers in Germany (see Figure 7 for information on the products and sales markets).

The competitive session has three rounds (it is essential to ensure that the simulated environment is initialized so that the training data is removed). Separating team members, i.e., not sitting in adjacent spaces in the classroom, provides a collaboration challenge. The separation forces the teams to rely on SAP®, to develop communication techniques, and for each member to focus on their assigned role. We have used this simulation during remote classes with students in various locations and communicating with a web-conferencing tool such as Zoom® or Teams®.

Once the final round is complete, the instructor discusses the simulation's BPs (about 30 minutes). While the job aid (see Figure 7) contains a process-like diagram, it is not a BP; it is the relationship between the SAP® functions. The instructor clarifies that the BP includes the activities performed by people and the IS, i.e., the ERP system is a resource used by the process, and it is responsible for certain activities in the process. Therefore, the BP diagram will have a lane for SAP®. The instructor emphasizes that the BP diagram shows why each SAP® function is used, e.g., what needs to be done prior to the change in pricing, what needs to occur to cause inventory to be ordered. Further, the ERP simulation allows the instructor to discuss two concepts: time-initiated processes and process-related data.

Sometimes a time-based frequency initiates a process, which a BPMN diagram shows with a timer event symbol. A timer event symbol is a double-lined circle that contains a clock face; its label defines the time-based rule (see the start of the processes in Figure 8). In other words, a clock-based event instantiates these processes, e.g., every ten minutes, every two hours, every morning, on the fifteenth of the month.

The ERP BP introduces the concept of unconditional parallelism. The product manufacturing exercise introduced the concept of conditional parallel paths, i.e., the inclusive gateway. The ERP BP allows the instructor to introduce a BPMN parallel gateway (a diamond with a plus sign), which is used when a condition is not needed to split the path into two or more paths. Just as with the inclusive gateway, parallel gateways are used in pairs (see the end of the Inventory Lane in Figure 8). The diagram also includes data storage (a disk icon) and data flow (a dotted line path with arrowhead) that sends data to or retrieves data from the data storage (see Figure 8).

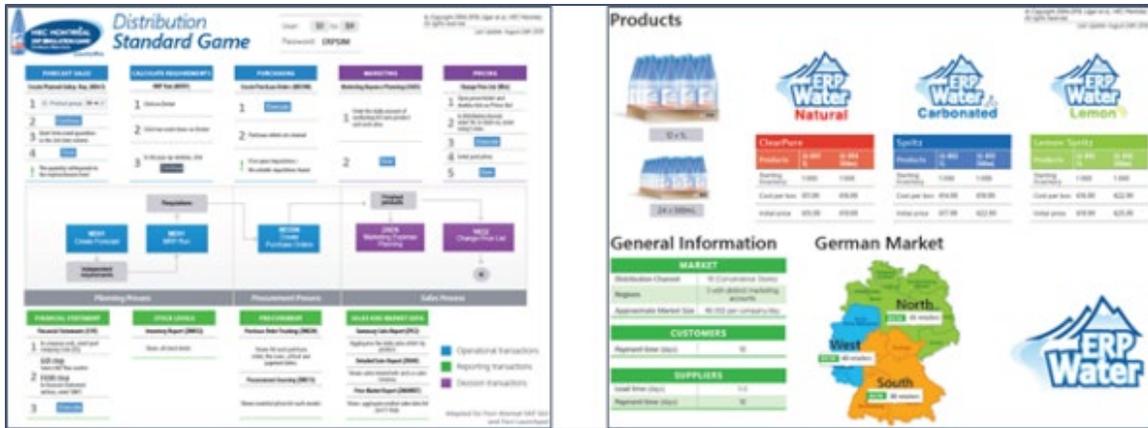


Figure 7. ERP Simulation Game Job Aid (Léger et al., 2018; used with permission of HEC Montreal)

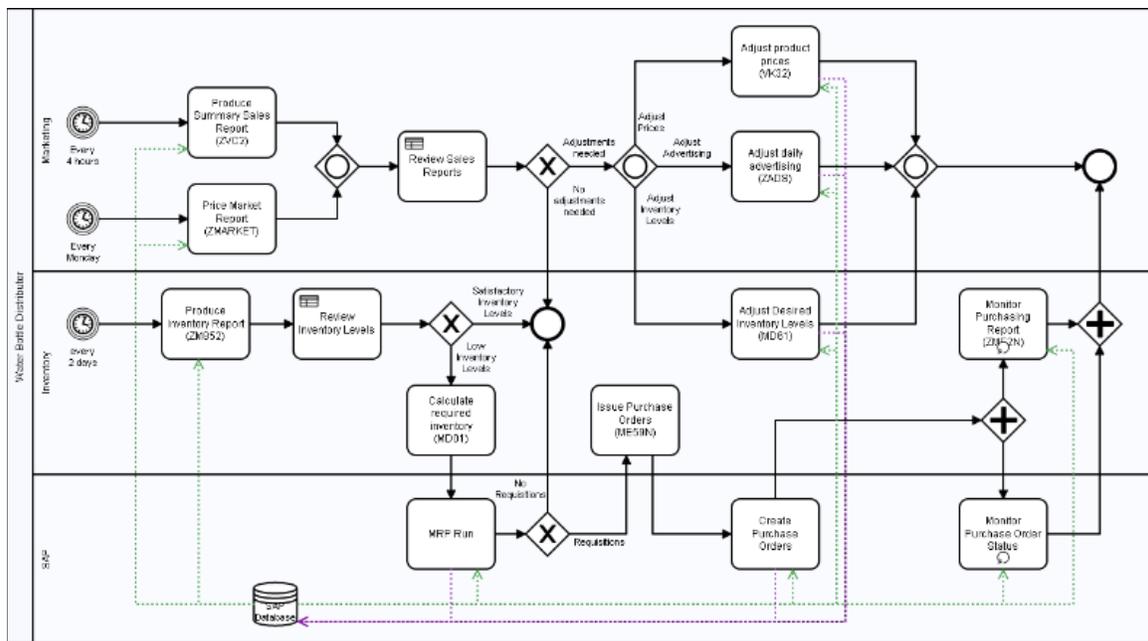


Figure 8. Sample SAP® Simulation BPMN Diagram

Students are instructed to create a BPMN diagram of the BP they used during the ERP simulation. The BPMN diagram needs to meet the Grading Rubric criteria BPMN Rules, Process, Roles, and Data in the Appendix. Because the instructor provides minimal guidance, the diagram has the highest overall grade (see the Grading Rubric Section of the Appendix). The Process and BPMN Rule criteria have the same and highest weight (students should have mastered these skills), the Data criterion has a lower weight (this is a new skill), and the Roles criterion has the lowest weight (this skill should be mastered) (see the Appendix).

4. EVIDENCE OF EFFECTIVENESS

The pedagogic approach to teaching BP concepts has evolved over several semesters. Students commented on the exercises in the university's end-of-semester survey. For instance,

"The class assignments and projects/activities we participated were fun, [sic] and beneficial to my learning! It created a fun way to meet new classmates and collaborate with others while learning the material."

"I liked the gift process diagram project we did [sic] it really made it easier to understand business process diagrams."

"The hands-on candy gift package assignment we did in class was great to connecting it to using business process diagrams were [sic] fun, especially the product production."

"I enjoyed the candy activities in class, hands-on learning stimulates me the most."

Similar comments were received by the authors directly from students. A survey was provided to students in two classes totaling 86 students, of which 63 responded (see Table 2). The survey consisted of eleven questions answered using a seven-point Likert scale (1 = Strongly Disagree and 7 = Strongly Agree). The questions were grouped into 1) opinion on learning; and 2) opinion on studying. Figure 9 shows the questions and average responses. A Pearson correlation coefficient was calculated between each question pair (see Figure 10). The analysis shows a moderate to strong correlation between many of the questions. The strongest correlation ($r > 0.8$) is between questions E8_2 and E8_3: the opinion of learning with the M&M candy and Card Sorting exercises, respectively. E8_2 and E8_1 (the BP diagramming tool, Cawemo®) also exhibit a strong correlation ($r > 0.7$). The students' rating and the strong correlations are an indication that the initial exercises were perceived similarly and found to be helpful to learning. Questions E9_3, E9_4, and E9_5 have a strong correlation ($r > 0.7$): studying BP concepts, understanding how technology is related to the student's major, and the exercise will help the student in their career, respectively. The strong correlation between these responses and the students' agreement indicates that the exercises helped students study and prepare for advanced coursework incorporating BP. Further corroboration of the perceived usefulness of the exercises was provided in comments that students provided in the survey. For example:

"Although the subject is dry, the diagrams did help me better understand business processes."

"I had a [sic] no idea about a business process before all, after [this] class and talking with my group members; I feel I have a strong grasp of the material."

"I think the use of the classroom and hands-on activities really helped put real-world items into the classroom setting."

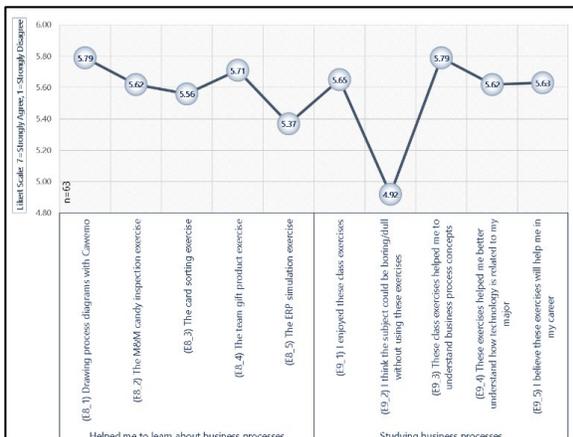


Figure 9. Average Survey Responses (all classes)

"I believe that the exercises in class were very beneficial to my learning experience. Without them, I may have had more difficulty grasping the concepts of each business process, and I think that doing hands-on activities helped me to better understand the importance of the finer details of each process."

Students from two classes completed the survey. A t-Test was performed to determine if both classes' provided answers that were the same. As shown in Figure 11, the responses were not equal ($P(T \leq t) < \alpha: 0.025336 < 0.05$), and the actual difference is large (Cohen's D).

As shown in Figures 12 and 14, the two classes' provided opinions of the exercises that diverged in question E8_2 (M&M candy), E8_4 (gift product), E9_2 (the subject would be boring), and E9_3 (the exercises helped learning). While most of class 2's responses have a moderate to high correlation (see Figure 15), there was less correlation than in class 1.

There could be several reasons for the difference in class responses. First, the survey was completed by 81% of the students in class 1 and 61% in class 2. Since the survey respondents self-selected, there could be sample bias. Second, the classes occurred in different academic semesters; there could be variance in the researcher's delivery of the exercise. Third, the exercises occurred in a classroom for class 1. However, class 2 did the first three games in a classroom, but the final game occurred virtually (the class delivery was changed due to the novel Coronavirus pandemic). Environmental factors may have influenced responses, e.g., student stress and remote access. Finally, the characteristics of the students in a class vary, e.g., gender, age, major, academic standing, nationality, academic ability. These characteristics could influence the responses; however, such characteristics were not included in the analysis.

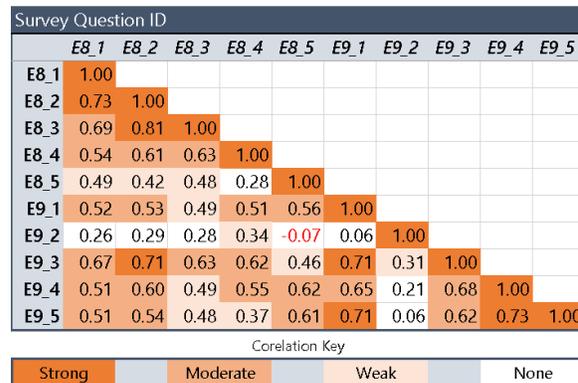


Figure 10. Correlation of Survey Question Responses (all classes)

	n	Number Students	Response Rate
Class 1	43	53	81.1%
Class 2	19	33	57.6%
Total	62	86	72.1%

Table 2. Survey Response Rates

Cohen's D	1.254
tStat	-2.67686
P(T<=t) two-tail	0.025336
T Critical two-tail	2.162157
α	0.05

Figure 11. t-Test of Class Responses



Figure 12. Average Survey Responses (class 1)

In Classroom	E8_1	E8_2	E8_3	E8_4	E8_5	E9_1	E9_2	E9_3	E9_4	E9_5
E8_1	1.00									
E8_2	0.74	1.00								
E8_3	0.70	0.92	1.00							
E8_4	0.62	0.66	0.68	1.00						
E8_5	0.46	0.53	0.57	0.39	1.00					
E9_1	0.74	0.65	0.64	0.58	0.72	1.00				
E9_2	0.20	0.17	0.16	0.24	-0.19	-0.07	1.00			
E9_3	-0.75	0.74	0.68	0.63	0.54	0.75	0.15	1.00		
E9_4	0.53	0.58	0.60	0.61	0.77	0.68	0.02	0.65	1.00	
E9_5	0.47	0.52	0.50	0.41	0.64	0.75	-0.11	0.60	0.72	1.00

Figure 13. Correlation of Survey Question Responses (class 1)



Figure 14. Average Survey Responses (class 2)

Remote class	E8_1	E8_2	E8_3	E8_4	E8_5	E9_1	E9_2	E9_3	E9_4	E9_5
E8_1	1.00									
E8_2	0.77	1.00								
E8_3	0.73	0.52	1.00							
E8_4	0.36	0.36	0.44	1.00						
E8_5	0.54	0.35	0.42	0.20	1.00					
E9_1	-0.07	0.10	0.03	0.15	0.35	1.00				
E9_2	0.54	0.38	0.41	0.46	0.31	0.18	1.00			
E9_3	0.57	0.54	0.46	0.38	0.57	0.52	0.54	1.00		
E9_4	0.52	0.60	0.18	0.31	0.48	0.53	0.49	0.78	1.00	
E9_5	0.63	0.59	0.43	0.15	0.64	0.57	0.39	0.73	0.75	1.00

Figure 15. Correlation of Survey Question Responses (class 2)

5. DISCUSSION AND CONCLUSION

The previous sections describe a hands-on game sequence that successively illustrates BP concepts. Rather than describing these concepts, which can seem abstract, confusing, and complex, these multi-level games provided experiential learning activities that apply to various students, e.g., IT, business, art, liberal arts. Monk and Lycett (2016) introduced business concepts in their first game while we used everyday activities that are analogous to business concepts in our first two games. The first game, inspecting a bag of M&Ms, introduced the foundational concepts of starting and ending a process, activity, and gateways. The game also introduced process analysis, e.g., what is the first step, what happens next? The process of sorting a deck of cards in the second game introduced the foundational concept of process role, e.g., identifying who is responsible for an activity. Having learned about activities,

gateways, and roles, students played the third game, an ERP simulation. Working in teams, students operated a simulated company where they used the information provided by the ERP system to set advertising budgets, inventory levels, and prices and order inventory using the ERP system. During the game and as they created their company's BP model, students learned more advanced BP and modeling concepts, e.g., data flow, encapsulation, event, parallelism. Further, they learned the relationship between an IS and BP, which is graphically evident in their business model, e.g., the IS activities are located in the ERP system's role in the diagram.

Throughout the pedagogic maturation of these exercises, the authors have observed increasing student engagement, excitement, and understanding of the BP concepts. Anecdotally, several non-IT students indicated how they expected studying BPs to be complicated; however, these

students were excited to have learned about BPs and expect to be using this knowledge in subsequent classes and their work.

Students were invited to complete a short survey after the activities (to incentivize the students, starting the survey contributed points towards their class grade); the activities were found to be effective. However, there are significant differences in the responses by different classes (Cohen's $D > 1.0$ and t -Test < 0.05) that highlight certain limitations. First, students self-selected to complete the survey, which may have introduced sample bias. Second, while the same instructor delivered the exercises to each class, there could have been differences in the delivery. Third, the environment for the second class changed after the third exercise; the class was delivered remotely, which could have introduced student stress and reduced comprehension. Fourth, the characteristics of each student and each class vary, which can cause differences in comprehension and perceptions. Nevertheless, both the empirical and the authors' anecdotal data indicate that the multi-leveled, game-based learning approach to BP is effective. Future work should consider evaluating the effectiveness of these MLGBL activities compared to other pedagogic methods. Also, student and class characteristics best suited to this pedagogical method should be identified.

The anecdotal evidence from comparing the class responses and the author subsequent experience with using the exercises in remote classes highlights a challenge with experiential learning: delivering the activity to students who are not co-located in or synchronously attending a class. Future work should seek adaptations to accommodate these challenges.

Presently, these exercises are used to teach BP concepts to a moderately-sized (e.g., 20 to 35 students) introductory IS course. Using these exercises with a larger class will need teaching assistants. In addition to using the exercise sequence, with some creativity, the exercises can be applied in whole or part to other teaching needs, e.g., BP management, BP improvement, quality assurance and control, critical thinking, and creative thinking.

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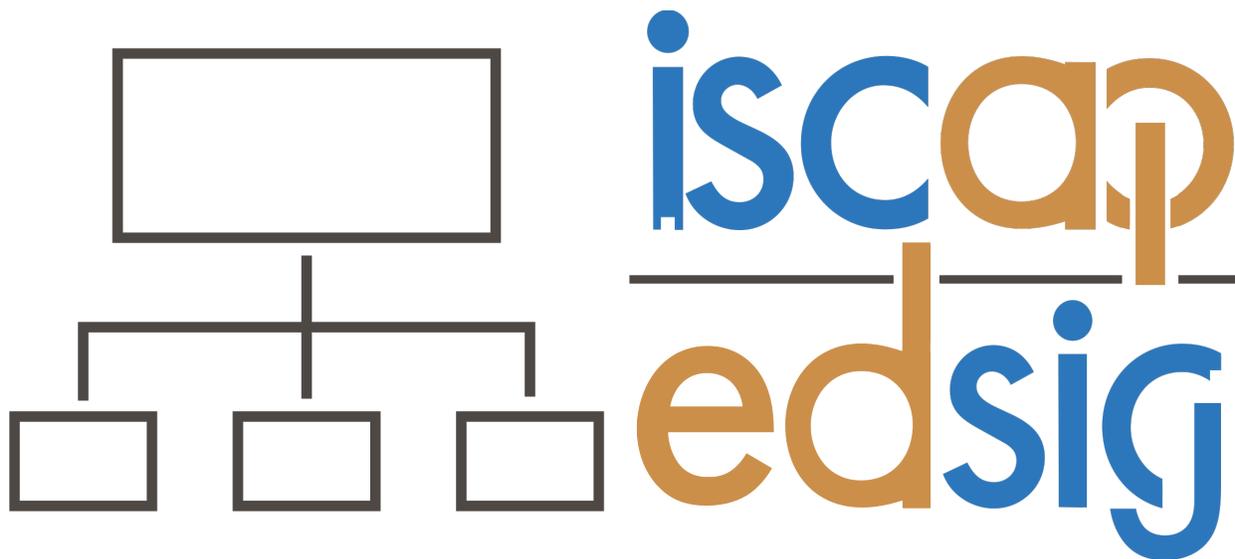
APPENDIX

Game Summary

	Simple Inspection Process		Simple Role-based Process		Dependent Discrete Processes		Complex Business Process with an IS	
Game	M&M inspection		Card Sorting		Manufacture Gift		ERP Simulation	
	<ol style="list-style-type: none"> 1. Give each student or pair of students a bag of M&Ms 2. Ask students to provide a count of the defective M&Ms (do not define 'defective') 3. Help students identify the steps in the process and create a diagram with Start, Activity, Gateway, and Stop symbols 		<ol style="list-style-type: none"> 1. Give each team a deck of cards 2. Remove Aces and place them on the table 3. Shuffle the remaining cards (including jokers and instructions) 4. Goal – have all cards placed on the correct suite pile sorted from Ace to King Rule 1 – only one person may place a card on a pile Rule 2 – a person may hold only one card; cards must remain in a pile 5. Round 1 – All players may select a card and place it in a suite pile 6. Round 2 – Assign a dealer; everyone else is assigned a suite. Only the dealer may select a card from the pile. He can only give it to a specialist when they do not have a card. She must move the game as fast as possible. 7. Help students to understand how to use a Pool to represent the activities assigned to a role. 8. Ask each student to create a diagram for the second round. 		<ol style="list-style-type: none"> 1. Ask the teams to design a gift candy product using the materials provided 2. Ask the teams to assign members to a role; only a role may perform assigned tasks. 3. Ask the teams to make products 4. Second round: 5. Ask the team to design another product that can be made simultaneously 6. Ask the teams to make both products simultaneously 7. Ask the team to create a high-level diagram of the process between the roles. 8. Ask each student to update their role with the process they used 		<ol style="list-style-type: none"> 1. Use practice rounds to train teams to set the advertising budget, the product prices, and to order new inventory 2. Run three rounds of teams running their company 3. Help students to understand a time start event, data flow within the process, and the role of the ERP system 4. Ask students to create a diagram of running their ERP simulation company 	
LO 1	Introduce		Introduce		Reinforce		Master	
LO 2	Introduce		Introduce		Reinforce		Master	
LO 3					Introduce		Reinforce	
BP Concept	<ol style="list-style-type: none"> 1. Start 2. Stop 3. Activity 4. Exclusive Gateway 		Role (Pool)		Inclusive Gateway		<ol style="list-style-type: none"> 1. Time start Event 2. Data Flow 3. Collapsed Pool 	
Teams	1 or 2 students		3 to 5 students		5 to 8 students		1 or 2 students	

	Simple Inspection Process		Simple Role-based Process		Dependent Discrete Processes		Complex Business Process with an IS	
Materials	1 bag of M&Ms for each student		1 deck of playing cards for every 5 students		Candy (e.g., M&Ms, jellybeans) Craft materials (e.g., tissue paper, index stock, pipe cleaners, ribbon, tape, glue, glitter pen, markers, scissors, hole punch)		Hec Montreal ERP Simulation	
Time	1-2 hours		1-3 hours		2-6 hours		6-8 hours	
Grading Rubric	<i>2% of overall Grade</i>		<i>3% of overall Grade</i>		<i>5% of overall Grade</i>		<i>10% of overall Grade</i>	
		<i>Criteria Weight</i>		<i>Criteria Weight</i>		<i>Criteria Weight</i>		<i>Criteria Weight</i>
Activities	Each activity contains a clear, concise description. Notations are used to provide additional information.		(Included in BPMN Rules criteria)		(Included in BPMN Rules criteria)		(Included in BPMN Rules criteria)	
Gateways	Each Gateway contains: 1. A label of what rule is being used. 2. The condition that must be met for the process to continue along each exit path 3. ensures that the Gateway can be exited on a single path.		(Included in BPMN Rules criteria)		(Included in BPMN Rules criteria)		(Included in BPMN Rules criteria)	
Process	1. There is a clear starting point 2. There is at least one appropriate ending point 3. All activities can be reached; no step within the process cannot proceed to the next step 4. The inspection criteria are clearly defined 5. Produces a count (log) of each type of defect detected		20% 1. It continues until all cards are sorted 2. Does not provide a card to a busy suite specialist 3. Always has the cards sorted on the suite piles		30% Your role in the process: 1. Contains all necessary activities 2. Contains all decisions 3. It shows how you checked that you received anything needed 4. Show how two products were handled simultaneously 5. It shows what you provided to the successor role		35% 1. the diagram represents the advertising, pricing, and procurement process(es) with at least one start and at least one exit 2. the diagram contains sufficient detail to understand the business process, e.g., sub-processes and collapsed pools are used appropriately	

	Simple Inspection Process		Simple Role-based Process		Dependent Discrete Processes		Complex Business Process with an IS	
BPMN Rule	N/A		The process meets the BPMN criteria for Start, Stop, Activities, Gateways, and overall process defined for the Simple Inspection Process game.	40%	1. The process meets the BPMN criteria for Start, Stop, Activities, Gateways, and overall process as defined for the Simple Inspection Process game 2. Inclusive Gateways are used in pairs	20%	1. The process meets the BPMN criteria for Start, Stop, Activities, Gateways, and overall process defined for the Simple Inspection Process game. 2. Inclusive and Parallel Gateways are used in pairs 3. Timer Start Events are used to initiate processes	35%
Roles	N/A		The process identifies the Dealer and Suit Specialist Roles; all activities are placed in the appropriate pool lane.	30%	N/A		The SAP® system is represented as a role (either in the main pool or a separate collapsed pool)	10%
Data	N/A		N/A		N/A		1. Each activity appropriately shows the data that it uses 2. Each activity appropriately shows the data that it creates	20%



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