Teaching Innovation Grant Application

Cover Sheet

Faculty Team Information

Primary Investigator/ Representative for Faculty Team

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Approvals

In submitting this proposal, the Primary Investigatory / Representative for the Faculty Team verifies that the proposal has been approved by the undersigned and that relevant scheduling and support considerations have been discussed.

Primary Investigator/Representative for Faculty Team:

Print Name: Dr. Liu (Willow) Yang Date: 12-3-2021

Signature: [signature]

Department Chair:

Print Name: Dr. Gerald Kohers Date: 12-3-2021

Signature: [signature]

Dean: Dr. Mitchell Muehsam

Print Name: Date: 12/3/2021

Signature: [signature]

Proposal Title: Impact of transactive memory systems on team performance in a competitive simulation game

Business students have traditionally found the Operations Management (OM) course challenging due to limited exposure to the discipline and difficulty with the quantitative aspect of the course. We introduce a new, smartphone-based, and customizable simulation game to enhance collaborative and experiential learning experience for OM students. In addition, as organizations today increasingly require students to work proficiently in teams in both a face-to-face and a remote setting, we aim to use factor analysis and structural equation model to understand how software ease of use, instructor contribution, and team collaboration impact a team's development of transactive memory systems (TMS) with the mediation of "lone wolf" phenomenon, and the effect of TMS on the team performance. A survey instrument will be developed and sent to OM students to complete in Spring, Summer, and Fall semesters in 2022.

High-Impact Practices (HIP) checklist

Check all that apply. Applicants are urged to contact PACE with any questions related to incorporation of HIPs in their proposal.

☒ Collaborative learning
☒ Project-based learning
☐ Improvement/development of a writing intensive course, writing-to-learn
☐ Service learning, or community-based learning
☐ Undergraduate scholarship
☐ Capstone experiences
☐ First-year and transitional experiences
☐ Curriculum improvement
☐ Learning communities and linking of courses
☐ Online course design/improvement
☒ Incorporating critical thinking
☒ Active learning-course redesign
☐ Competency-based course design
☐ Retrieval practice
☐ Interleaving
☐ Student metacognition
☒ Other (transactive memory system)

HIPs generally:

- Involve a greater student investment of time, effort, and purposeful attention to learning.
- Allow students to interact with faculty, staff, and peers concerning substantive matters, and build sustained, substantive relationships.
- Allow students to experience diversity and engage people across their differences.
- Involve a student-centered approach to the curriculum or development of competencies.
- Involve frequent and substantive feedback for students.
- Provide opportunities for students to discover the relevance of, and apply, integrate and synthesize knowledge gained in and out of the classroom within the context of real-world applications and new situations.
- Provide the opportunity for students to be meta-cognitive and reflect on their experiences and the person they are becoming.

Resources

Resources to assist you in development of your plan:

- Course Transformation Guide from Carl Wieman Science Education Initiative at the University of British Columbia - http://www.cwsei.ubc.ca/resources/instructor_guidance.htm
- Impact of faculty development reports, Association of College and University Educators - http://acue.org/about/impact/
- Description of some HIPs from AACU - http://www.aacu.org/leap/hips
- Summary of the excellent *Make It Stick*, from Belknap Press (2014) - https://onlinelearninginsights.wordpress.com/2015/07/21/make-your-teaching-stick-with-ideas-from-make-it-stick-the-science-of-successful-learning/

Project Plan

See the attached PDF file.

Budget

The research project budget is $9,000. The budget includes $6000 for faculty stipend, $2,000 for each faculty research team member (Dr. Liu Yang, Dr. William Ellegood, and Dr. Jason Riley).

Additionally, we request $3,000 for project expense to reduce students' cost when purchasing access to the simulation tool. The cost to access the *Medica Scientific* simulation game is $18 per student. We estimate 500 students will participate in this research. Therefore, with the $3,000 for project expense we will be able to reduce each student's cost by 33%.

Budget Outline

Item / Stipend	Cost per Unit	Quantity	Total Cost	Justification / Purpose
Faculty stipend	$2,000	3	$6,000	Three faculty research team members: Drs. Liu Yang, William Ellegood, and Jason Riley
Simulation software expense	$3,000	1	$3,000	The cost to access the simulation game is $18 per student. We estimate 500 students will participate in this research. With the support of $3,000, we will be able to reduce each student's cost by 33%.

Grand total: $9,000

Philosophical/Pedagogical Backdrop

For students to be successful in today's business environment, they must be able to work proficiently in teams in both a face-to-face and a remote setting. However, hiring managers find most recent college graduates lack soft skills, such as teamwork (Dishman, 2016). Organizations have long realized that a group of individuals working together and drawing upon their combination of knowledge can achieve more, faster than individuals working alone. Both practitioners and academics want to understand how teams work and use the knowledge contained within these units. To do so, many researchers study transactive memory systems (TMS), as they help explain how groups structure, process, and share knowledge by clarifying how they jointly encode, store, and retrieve relevant information (Wegner, 1987; Lewis, 2003).

To explore the impact of the learning tool, the instructor's, and teamwork on a team's performance, we investigate how software ease of use, instructor's contribution, and team collaboration affect TMS through the mediation of "lone wolf" phenomenon. We utilize a new, smartphone-based simulation tool to examine how these constructs affect a team's performance in Operations Management (OM) course. First, prior research has shown that software ease of use has a positive relationship with students' acceptance of the concepts used within simulations resulting in better comprehension of operations management concepts taught in class (Riley & Ellegood, 2020). Second, Wiggins et al. (2017) found that instructor's contribution was an important factor for achieving student engagement in active learning exercises. Third, team collaboration allows a team to effectively benefit member's knowledge, skills, and abilities (Behar et al., 2008). Last, the lone wolf phenomenon has been shown to have a negative impact on team performance (Barr et al., 2005). Understanding how the three constructs interact and are mediated by the lone wolf phenomenon still needs further study. Thus, we frame this research using experiential and collaborative learning theory and illustrate how teams encode, store, retrieve and communicate knowledge between the different knowledge domains (Brandon and Hollingshead, 2004). Leveraging this theoretical frame, we answer the following questions:

1. How does software ease of use affect TMS?
2. How does the "lone wolf" phenomenon mediate the linkage between software ease of use and TMS?
3. How does instructor's contribution affect TMS?
4. How does the "lone wolf" phenomenon mediate the linkage between instructor's contribution and TMS?
5. How does team collaboration affect TMS?
6. How does the "lone wolf" phenomenon mediate the linkage between team collaboration and TMS?
7. How does TMS affect team performance?

An extensive body of research has demonstrated that experiential learning and collaborative learning are effective pedagogical practices. Dr. William Ellegood and Dr. Jason Riley, investigators of this project, have previously studied these practices and have two publications on the topics. Experiential learning focuses on the creation of a "learning by doing" environment, where students move through four stages of learning: concrete experience, abstract conceptualization, reflective observation, and active experimentation (Kolb, 1984). Existing research shows that experiential learning activities typically enable students to better understand the course material and lead to higher retention rate for universities (Kozar and Marcketti, 2008; Riley & Ellegood, 2018). In the OM field, experiential learning has been strongly advocated as it gives students the opportunity to "visualize" real-life operations and "experience" the process of making complex operational decisions (Yalabik, 2012; Wilson, 2018).

Collaborative learning is a form of social learning where people learn from and with others. From a pedagogical standpoint, it refers to an instructional method that involves joint intellectual effort of students and emphasizes student interactions by working in small, structured groups (Smith and MacGregor, 1992; Dillenbourg, 1999; Lai, 2011). Collaborative learning includes a variety of group-based instructional techniques that are centered on students' exploration or application of the course material. On a broader perspective, cooperative learning (where students work in groups but are assessed individually) is part of collaborative learning (Millis and Cottell, 1998; Prince, 2004). Chad et al. (2017) and Chad et al. (2018) show that collaborative learning improves retention of college students in general and positively influences student's openness to diversity. Yazici (2004) specifically investigates the use of collaborative activities in OM classes and finds that collaborate learning improves analytical competency, and strategic and critical thinking capability of undergraduate business students.

As an active learning tool, the group simulation game, is both an experiential and a collaborative learning activity. There is a long tradition of using games in OM education to teach one or a set of subjects, and it is well documented that games improve both students' understanding and interest in OM (Ammar and Wright, 1999; Lewis and Maylor, 2007). Games have different formats, ranging from playing on paper or the use of physical objects, to computer-based simulation game. Some of the early games include *The Cups Game* (Jackson, 1996) to understand the difference between push and pull production, *The Distribution Game* (Muckstadt and Jackson, 1995) to understand the concepts and decision-making related to inventory and safety stock, and *ABC's Manufacturing* (Ammar and Wright, 1999) for production planning. With the advancement of technology and changing business environment, games employed in OM continues to evolve. Wilson (2018) introduces an "offline" game to enable students to explore bottlenecks in OM, and Riley and Ellegood (2018) investigate the effect of computer-based simulation game on different student populations taking OM classes. To the best of our knowledge, there have not been studies on the use of smart-phone-based simulation game in OM. In this project, we aim to explore a new simulation game that runs entirely on a smart phone and investigate its effect on student's engagement and learning outcome.

Inclusive, Student-centered Implementation Plan

OM is a mandatory course for undergraduate students in most business schools, including the College of Business Administration (COBA) at SHSU. OM covers a wide range of concepts and quantitative methods that are critical to manufacturing and services organizations. Business students have traditionally found the course particularly challenging because a) despite prerequisite requirement in mathematics, many students are not well equipped for the quantitative techniques and data-based decision-making required in the OM class; and b) lack of experience and limited exposure to business operations make it difficult for students to appreciate and comprehend the material (Mukherjee, 2002; Yazici, 2004; Pal and Busing, 2008). The OM faculty at COBA have developed/employed a variety of experience learning activities to improve students' understanding of the quantitative and qualitative business concepts discussed in OM. To further improve OM teaching outcome and to understand the factors affecting the effectiveness of a simulation game and team performance in general, we plan to experiment on a new simulation game that can be tailored to SHSU students, the *Medica Scientific* simulation.

The *Medica Scientific* simulation, published by Processim Labs, is a smartphone application which gamifies many of the operations management topics covered in class into a single simulation software tool. Marriott et al. (2015) found simulations to be an active learning technique that enhanced learning. Business simulations enable students to learn different strategies, while managing potential conflicts (Martin and McEvoy, 2003). Within the *Medica Scientific* application, teams manage a manufacturing facility with two processing lines: a build-to-order line and a build-to-inventory line. For teams to be successful in the simulation, they will need to apply classroom concepts associated with forecasting, inventory management, capacity planning, resource management, pricing, cash flow management, and bottleneck analysis. The *Medica Scientific* application allows teams to experience these concepts in a simulated environment and exposes the teams to how these concepts are interrelated in business.

The *Medica Scientific* simulation offers two unique benefits. First, its smartphone-based platform allows students to access the game anywhere and makes it much easier for students to keep track of their teams' performance. Second, the provider is willing to work with us to customize some of the functions to best fit the need of the SHSU students. This gives our students a unique learning environment.

As a team-based simulation tool, the *Medica Scientific* encourages students to work as a team to apply concepts learned. Each team is responsible for a factory and makes forecasting, purchasing and capacity management decisions to maximize its cash position. We plan to let each team have three to four students and to test out two week-long segments. The first segment aims to help students understand the simulated environment and form team connections (Ritchie et al., 2013), and the second segment is designed for students to apply multiple OM concepts taught during the semester. We will give a greater level of instruction during the first segment.

The teams will be asked to manage the simulated facility for 7 days and 24 hours per day (168 hours), which is equivalent to 336 simulated days (each hour in real-time is two days in the simulation). The simulation tool requires students to monitor and iteratively change settings as a means to improve performance. Prior to the first simulation, students select a team to join with any students not joining a team being randomly assigned to a team by the instructor. As the simulation progresses, teams are ranked based on net profit (first to last). Following each simulation round, teams are to submit an executive summary discussing the objective, strategy, key performance indicators, and lessons learned. With a portion of a students' grade dependent on their team's ranking, students are likely very motivated to make decisions in the effort to improve teams' rank and net profit.

Assessment Plan

We intend to launch the *Medica Scientific* simulation game in Spring, Summer, and Fall semesters in 2022, which will impact approximately 500 business students at the SHSU. About 260-300 students will be in face-to-face sections (7 classes) and 200-240 of these students will be in online sections of OM (5 classes).

The outcomes of the new simulation on student learning will be assessed in three ways. First, the assessment will be based on the results of the simulation. If students make sound decisions during the simulation by applying the concepts learned, they shall see a good financial result. Second, the decisions that the students make will allow instructors to evaluate whether the students fully grasp the concepts of the subject matter, and the frequency of the decisions indicates the level of the engagement of a team. Third, students survey conducted after completing the simulation game will provide new insights into how various factors (including software ease of use, instructor's contribution, and team collaboration) affect team performance through the TMS.

The preliminary survey instrument has been developed based on extensive literature review. The measures for the sub-concepts (credibility, specialization and coordination) associated with TMS are adapted from Lewis (2003). We leverage questions from Riley & Ellegood (2018) for software ease of use, Wiggins, et al. (2017) for instructor's contribution, Mikkela (2019) for team collaboration, and Barr et al. (2005) for lone wolf phenomenon. A seven-point Likert scale will be used for all the primary measures, while the control variables will have different scales. Appendix includes preliminary survey questions and control variables.

We propose a structural model (Figure 1) to examine how software ease of use, instructor's contribution, and team collaboration impact a team's development of TMS. Additionally, we examine how the lone wolf phenomenon mediates the effect of these constructs on a team's development of TMS. The TMS dependent variable is a second-order construct, aggregated from team members' perception about specialization, credibility and coordination efforts (Lewis, 2003). The survey will be administered using Qualtrics, a web-based survey engine.

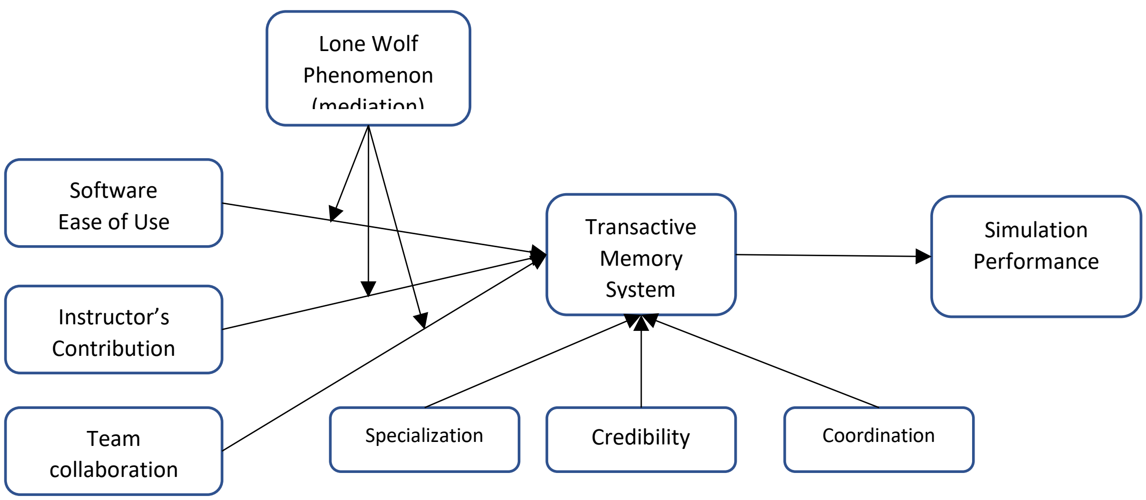

Figure 1: Structural equation model

Experience Sharing Plan

The information will be disseminated at conferences, publications, or other relevant outlets, including

- Decisions Sciences Institute (DSI) Annual Meeting
- PACE Center Teaching and Learning Conference
- Publication in a peer-reviewed journal, such as *International Journal of Production and Economics*, an A-ranked journal in production and operations management

Faculty Meeting Plan

The project will be executed through Spring, Summer, and Fall 2022. We plan to meet biweekly in Spring and Fall 2022 during the project implementation. After the project is completed, we will be focusing on the dissemination of the results and insights obtained from the project by publishing on a peer-reviewed journal and presenting in teaching and learning related conferences and the conference in the OM field.

Meeting Dates		**Planned Activities / Goals**
Spring 2022	1/6/2022	Discuss/agree on critical simulation-related components for OM syllabi in Spring 2022, including when to release to students; whether to use same schedule for both face-to-face and online sections; whether and how to bring the other OM faculty on board for the simulation game in Spring 2022
	1/20/2022	Discuss/agree on other simulation setups, including parameter initialization, difficulty level, customization requirements, assessment of student performance, etc.
	2/3/2022	
	2/17/2022	Discuss survey questions, literature to review, and prepare for IRB application. Target to have IRB approved in early March
	3/3/2022	
	3/24/2022	
	4/7/2022	Simulation progress review and making adjustments if needed
	4/21/2022	Student performance review
	5/11/2022	Survey results review; prepare for launching simulation in Summer
Fall 2022 (tentative, pending for Fall schedule)	8/16/2022	Confirm simulation-related components for OM syllabus in Fall 2022.
	8/30/2022	Review Summer survey results and students performance in summer OM classes.
	9/13/2022	Spring and Summer survey results coding; statistical analysis strategy
	9/27/2022	
	10/11/2022	
	10/25/2022	
	11/8/2022	Review fall survey results and students performance; strategy for publication and conference presentation
	11/22/2022	
	12/6/2022	Fall survey results coding; statistical analysis of 3 semesters.

Budget Justification

The research project budget is $9,000. The budget includes $6000 for faculty stipend, $2,000 for each faculty research team member (Dr. Liu Yang, Dr. William Ellegood, and Dr. Jason Riley). Additionally, we request $3,000 for project expense to reduce students' cost when purchasing access to the simulation tool. The cost to access the *Medica Scientific* simulation game is $18 per student. We estimate 500 students will participate in this research. Therefore, with the $3,000 for project expense we will be able to reduce each student's cost by 33%.

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Appendix: Survey Questions and Control Variables

Construct	Item	Question
Software ease of use	Soft1	My interaction with the simulation interface was enjoyable.
	Soft2	I found it easy to get the interface to do what I wanted it to do.
	Soft3	Interacting with the simulation did not require a lot of my mental effort.
	Soft4	I could use the simulation tool better than my teammates
Instructor's contribution	Inst1	The instructor's enthusiasm made me more interested in the simulation activity.
	Inst2	The instructor put a good deal of effort into my learning for today's class.
	Inst3	The instructor seemed prepared for the simulation activity.
	Inst4	The instructor were available to answer questions during the group activity.
Team collaboration	Team1	I feel happy when my teammates succeed.
	Team2	I receive help from my team if I need it.
	Team3	My teammates and I need each other.
	Team4	We work together with my teammates.
	Team5	We share our work load
Lone wolf phenomenon	Lone1	Given the choice, I would rather work alone than work with others.
	Lone2	I prefer solitude over social interactions with acquaintances.
	Lone3	For me, working with others poses a threat to my success.
	Lone4	I am more successful when I work by myself than withothers.
	Lone5	Working with others is a hassle.
	Lone6	I have little tolerance when others make mistakes.
	Lone7	I don't like attending team meetings where I have to listen to the simple-minded ideas of others.
Transactive memory systems (credibility, specialization and coordination)	Cred1	I was comfortable accepting procedural suggestions from other team members
	Cred2	I trusted that other member's knowledge about our simulation was credible
	Cred3	I was confident relying on the information that other team members brought to the discussion
	Cred4	I did not have much faith in other member's "expertise" (reverse)
	Spec1	Each team member has specialized knowledge of some aspect of the simulation
	Spec2	Different team members are responsible for expertise in different areas
	Spec3	The specialized knowledge of several different team members was needed to complete the simulation deliverables
	Spec4	I know which team members have expertise specific areas
	Coor1	Our team worked together in a well-coordinated fashion
	Coor2	Our team had very few misunderstandings about what to do
	Coor3	We accomplished the task smoothly and efficiently
	Coor4	There was much confusion about how we would accomplish the simulation
Team performance	Perf1	Rank at end of simulation
	Perf2	Cash balance at end of simulation
Control variables	Class	Current classification (freshman, sophomore, junior, senior, graduate student)
	Gend	Gender (Female, Male)
	FGen	First generation student (not first generation, first generation)

	Coll	Which college are you affiliated (COBA, CJ, COE, etc)
	Major	Primary academic major with COBA (accounting, economics, finance, etc)
	Age	Age
	Mode	Course delivery mode (online, face-to-face)
	Inst	Instructor