Case Study: The Impact of Moving a Simulation from Face-To-Face to Distance Modes

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ABSTRACT

The COVID-19 pandemic caused a rapid move from traditional face-to-face classroom education to various forms of remote learning. Early research suggests that some faculty successfully adapted to the shift from classroom to remote learning and it was possible for students to maintain the same level of academic engagement without compromising their learning. This study contributes to that early research by examining student opinions about simulations and academic teamwork following a simulation game experience conducted synchronously during face-to-face class meetings prior to the COVID-19 pandemic, asynchronously using remote-mode technology with synchronous remote debriefs during the early stage of the pandemic, and hybrid mode with a combination of face-to-face classroom sessions and remote team meetings during later stages of the pandemic. Synchronous debrief sessions were held either face-to-face or via web conference for all modes. This study found no significant differences in student attitudes and learning between the three modes and noted a wider variation of attitudes towards simulations following the late-stage pandemic hybrid approach.

INTRODUCTION AND LITERATURE REVIEW

The COVID-19 pandemic resulted in faculty shifting their face-to-face courses to online remote delivery using synchronous and asynchronous methods. A simple approach was to use web conferencing tools such as Zoom, Microsoft Teams, and Blackboard Collaborate to live stream the lecture from the professor's office at the originally scheduled class time, and in some cases, record these sessions and make them available for later asynchronous student viewing. While this is fine for the "sage on stage" lecturer with web conferencing experience where both students and lecturer have high-speed internet access to these tools, web conferencing can be complicated for faculty without online course delivery experience, especially those who had flipped their on-campus classroom and involved students in various forms of experiential activities involving in-class groupwork. Rather than use these tools, limited success was achieved by faculty who used simple chat tools they were already familiar with, such as WhatsApp, to transact curriculum with students with slow internet connections (Mishra et al., 2020, p. 7).

Sufficient internet connectivity is crucial when considering the learning effectiveness key predictive factors in COVID-19 online learning found by Tsang et al. (2021, p. 1): student-student dialogue, course design, and instructor-student dialogue. Those with sufficient connectivity and who were able to adapt found that the delivery mode shift "did not adversely affect academic engagement, and did not compromise either the quality or integrity of remote online learning" (Palia, 2021, p. 31). This success should come as no surprise as preCovid-19 research has found studies showing that online and flipped teaching methods are more effective than traditional lectures and that there is no significant relationship between teaching mode and student performance (Alhefnawi et al., 2021, p. 55).

While most agree direct measurement of learning is preferred to measure success, this is difficult because learning objectives are not always clear, team dynamics are often involved, and learning can occur while losing the game (Greenlaw & Wyman, 1973, p. 290; Gosenpud, 1990, p. 304). Tsang et al. (2021, p. 4) regard student satisfaction, which is influenced by student engagement and performance on learning assessments, as the ultimate indicator of learning effectiveness. While student perceptions and attitudes are not direct evidence of learning, they "are often postulated as an intervening variable between the pedagogy and learning; highly motivated students are likely to learn more" (Gentry & Burns, 1981, p. 49).

Simulation games are often used after students have learned the fundamental concepts of the discipline, either earlier in the current course or in the case of a capstone course, in an earlier course; however, they can also be used early in a course to help students discover what they don't know to create motivation for learning (Anderson & Lawton, 2003, pp. 1–2). Playing a project management simulation game as an activity towards the end of a single course and as a capstone activity in a series of project management courses has been found to improve student self-perceptions of their project management knowledge and confidence in their ability to apply that knowledge (McCreery, 2003, p. 233; Szot, 2013, p. 183). "Student attitudes towards teamwork in general and their classroom team in particular improved significantly [following the experience and] although opinions on the use of simulation games as a learning pedagogy were not strengthened as a result of playing the project management simulation game, they were favorable before the activity and remained so" (Szot, 2013, p. 183). This study compares student attitudes about teamwork and simulations following a project management simulation game played synchronously as a major course activity towards the end of a course in face-to-face mode prior to the COVID-19 pandemic, using remote-mode synchronous and asynchronous technology during

the early stage of the pandemic, and using hybrid-mode with a combination of face-to-face classes and online technology during a later stage of the pandemic.

METHODOLOGY

The simulation game was played as a major learning activity towards the end of a project management course in an executive-format systems engineering and management Master of Science program at a single university. The simulation game was administered in a similar manner in each of the three modes by the same professor. Twenty students played the game face-to-face in 2019, 19 played remotely in 2020, and 18 played in hybrid mode in 2021. Mixed methods are used to examine available postsimulation survey data from these three classes. Information about the delivery mode of these classes is shown in Table 1.

Table 1. Simulation game administration modes

Mode	Cohort	Students	Orientation	Executing	Final Debrief
Face-to-face	SEM19	20	Face-to-face March 16, 2019	Face-to-face March 30, April 13, 2019	Face-to-face April 27, 2019
Remote	SEM20	19	Web Conference November 7, 2020	Independent/Web Conf Nov. 8 through Dec. 11, 2020	Web Conference Dec. 12, 2020
Hybrid	SEM21	18	Face-to-face October 30, 2021	Hybrid Oct. 31 through Dec. 3, 2021	Face-to-face Dec. 4, 2021

In all modes of the program, planning for the simulation is a team homework activity that is completed prior to playing the game. Prior to completing this assignment, students are led through a dry run of the game during an orientation session and play several rounds to gain context for their planning and a preview of how well they can expect resources to perform on assigned activities. Beginning in 2020, all students prepared for this team planning activity by completing a prior individual assignment that was based on the planning required to prepare for playing the simulation game.

In the face-to-face mode, the actual playing and debriefing of the simulation game was conducted during live face-to-face class sessions lasting four and a half hours on Saturday afternoons. Student teams met during class time to play multiple periods in succession by entering decisions, receiving and analyzing results, and making decisions for the next period.

In the remote mode, all live contact was via web conferences lasting five hours on Saturdays using Microsoft Teams for initial instruction, interim reporting, and final reporting and debrief. In this mode, live classes were held via web conference during the regularly scheduled class time and student teams met independently via breakout session during class or at their discretion between classes to discuss simulation results and to make decisions for the next work period. Decisions were typically due every other day between class sessions during execution of the simulation game.

The hybrid mode was delivered similarly to the remote mode with face-to-face classes lasting five and a half hours replacing the live web conferences on class day. Simulation orientation, the dry run, initial simulation play, interim reporting, final reporting, and debrief were conducted face-to-face and later decision rounds were played as in remote mode with teams meeting independently to review results and make decisions through completion of the simulation.

The differences in class meeting durations during the three years were due to nuances of classroom availability affecting the number of sessions in the course. There were nine class sessions in 2019, eight in 2020, and seven in 2021. Course content was rearranged to fit the schedule and the simulation was similarly conducted as a capstone activity in each case.

In all cases, a final live debrief was conducted in conjunction with the teams' final presentations of results and reflections, either face-to-face or via web conference. After completion of the debrief, students were asked to respond to a survey indicating their level of agreement with statements related to academic teamwork in general, team experience during the simulation, simulations in general, and this simulation in particular using a standard Qualtrics seven-point Likert-like agreement scale (*Strongly disagree* (1)*, Disagree* (2)*, Somewhat disagree* (3)*, Neither agree nor disagree* (4)*, Somewhat agree* (5)*, Agree* (6)*, Strongly agree* (7)). The survey questions were presented to the students as two matrix-format questions and are the same as those used in a prior study involving the same simulation game (Szot, 2013, pp. 219–220) building on the prior research of McCreery (2003, pp. 233–242) and Buzzetto-Moore and Mitchell (2009, pp. 73–90):

- **Simulations as a learning tool.** Indicate your level of agreement with each of the following statements related to your general opinions of using simulations as a learning tool and about the simulation you just completed (16 following statements, variables s2_1 to s2_16).
- Assess your **team experience** throughout the simulation exercise including the pregame planning by indicating your level of agreement with each of the following statements (nine following statements, variables t2_1 to t2_9).

Mean values of responses to related questions were used to generate four variables: sg2, attitude towards simulation in general; sp2, attitude towards this simulation experience; tg2, attitude towards academic teamwork in general; and tp2, attitude towards teamwork in this simulation. Responses to the question "this simulation was difficult" (variable s2_16) did not correlate with other responses and were not used in the generation of these variables.

The statements related to each variable were:

- Attitude towards simulation in general (sg2)
  - Simulations allow students to see how course concepts are applied in real world practice (s2_1)
  - Simulations provide valuable real-world experience (s2_2)
  - Computer simulations help one better understand the decision-making process that occurs in professional practice (s2_5)
  - Simulations can make class more fun (s2_7)
  - Simulations help students build professional skills (s2_9)
  - I would like to see more simulations in future courses (s2_12)
- Attitude towards this simulation experience (sp2)
  - The Sim4Projects simulation we just completed was a valuable learning experience (s2_4)
  - The Sim4Projects simulation we just completed helped me understand key course concepts (s2_6)
  - I am pleased with my performance on the Sim4Projects simulation we just completed (s2_8)
  - I enjoyed the Sim4Projects simulation (s2_10)
  - I would be willing to work with my simulation team on an actual project in the future (s2_13)
  - The Sim4Projects simulation we just competed was educational (s2_14)
  - The Sim4Projects simulation we just competed was fun and exciting (s2_15)
- Attitude towards academic teamwork in general (tg2)
  - Group projects help prepare students to be able to work in professional groups in the future (s2_3)
  - I enjoy working in groups (s2_11)
- Attitude towards teamwork during this simulation: (tp2)
  - The workload was fairly balanced across all team members (t2_1)
  - Team members cooperated well throughout the exercise (t2_2)
  - Our team worked in an efficient manner (t2_3)
  - Team members all participated equally in the team decision making process (t2_4)
  - Our team maintained a pleasant working atmosphere (t2_5)
  - Our team worked out disagreements in an equitable manner (t2_6)
  - Team members were highly motivated to perform well in the exercise (t2_7)
  - Overall, I am satisfied with my team experience (t2_8)
  - I would be willing to work with my team on an actual project in the future (t2_9)

Stata/BE 17.0 for Windows (64 bit x86-64) Revision 17 Nov 2021 was used to analyze the data. Scale reliability was checked by calculating Cronbach's α for the four variables and a one-way ANOVA with Bonferroni multiple-comparison tests was run for each variable to summarize the data and to test for statistically significant differences between the cohorts.

Students were also asked to respond to the following discussion questions to provide insight about their experience:

- Team member performance. If you have a team member you believe deserves less than full credit on the simulation graded assignments for poor contribution or one who you believe deserves extra credit for outstanding contributions, list their name(s) here and describe your rationale for this assessment along with the percentage you recommend applying to the related scores. Feel free to include yourself in this evaluation.
- What did you like about the just-completed simulation experience?
- What did you learn about project management from participating in the simulation?
- What changes do you think could be made to the overall simulation experience to better prepare you to manage projects?
- What have you learned from this course that you are already applying on the job?
- What aspects of the course delivery should NOT be changed for future offerings of the course?
- What changes do you recommend for future delivery of this course and why?
- What other comments or recommendations would you like to convey?

Responses to these questions were examined to identify emergent themes and any differences between the cohorts.

The survey closed with level of agreement questions related to the structure of the course using the same interval scale of 1 (strongly disagree) to 7 (strongly agree):

- I prefer a hands-on approach to learning and recommend that future classes include more recorded lectures as part of the prework to allow more class time devoted to exercises, case studies, simulation, etc. (variable prefhandson)
- The simulation game was a valuable learning experience and should be retained in the course (variable keepsim)

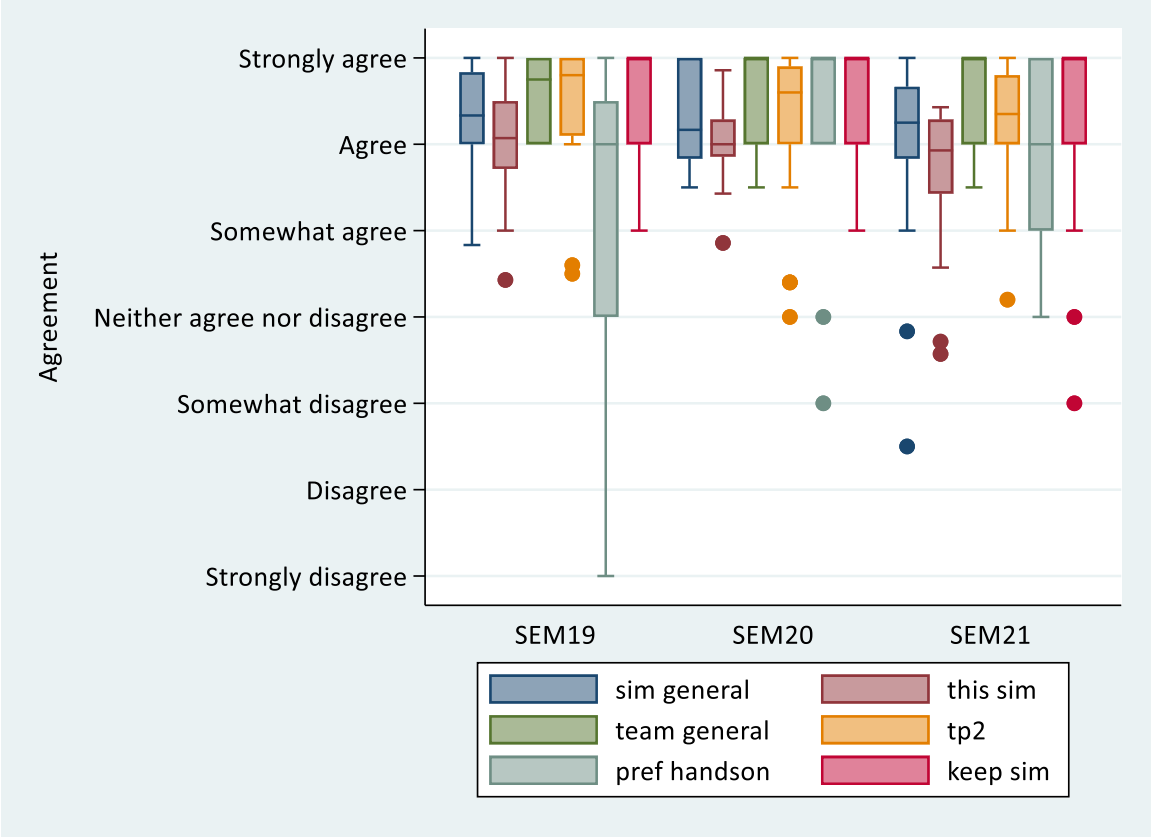
Again, a one-way ANOVA with Bonferroni multiple-comparison tests was run for each variable to summarize this data and to test for statistically significant differences between the cohorts.

RESULTS

The scale reliability check by calculating Cronbach's α found all had high reliabilities except tg2, attitude towards academic teamwork in general: sg2 α = .9288, sp2 α = .8624, tp2 α = .9477 and tg2 α = .5395. This lower value for tg2 is expected since it is a scale with just two items (Acock, 2016, p. 379) and "a test need not approach a perfect scale to be interpretable. Items with quite low intercorrelations can yield an interpretable scale" (Cronbach, 1951, p. 332).

Examination of box plots of the six variables in Figure 1 show 75% or more of the students agree with these statements for all variables except preference for hands on learning by the 2019 face-to-face class. This variation in preference for learning

Figure 1. Postsimulation student attitudes



approach does not appear to influence the attitudes towards simulations and academic teamwork. The 2021 hybrid class has more varied opinions than either the 2019 face-to-face class or the 2020 remote class.

One-way ANOVA with Bonferroni multiple-comparison tests found no significant differences between the cohorts except for the previously mentioned preference for hands-on learning by the 2019 cohort which differs significantly from the 2020 cohort ($p < .05$) but not the 2021 cohort. The variable means and standard deviations from this analysis are listed in Table 2 and show that, on average, attitudes are favorable towards simulations in general, this simulation experience, teamwork in general, teamwork experience, hands-on learning, and keeping the simulation in the course.

Responses to the discussion questions aligned with the satisfaction suggested by the quantitative scoring. Overall, students liked the simulation experience and the course structure, regardless of mode. Similar comments were found from each of the cohorts.

Table 2. Variable summary (mean scale: 7 = strongly agree, 6 = agree, 5 = slightly agree)

	Simulations in General		This Simulation		Teamwork in General		My Team		Prefer Hands-on Learning		Keep Simulation	
Cohort	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
SEM19	6.342	0.5445	6.0214	0.6012	6.575	0.4666	6.425	0.7545	5.05	1.9050	6.6	0.5982
SEM20	6.298	0.5169	6.0000	0.4124	6.605	0.4882	6.200	0.9574	6.263	1.0976	6.526	0.6118
SEM21	5.954	1.1727	5.6349	0.8727	6.583	0.5491	6.289	0.7251	5.833	1.0431	6.278	1.1785
Total	6.205	0.7962	5.8922	0.6631	6.587	0.4921	6.307	0.8102	5.702	1.4876	6.474	0.8260

In the remote and hybrid course modes, there were no complaints about the need for frequent team meetings between scheduled course sessions to complete the simulation game and there were multiple positive comments about the learning that occurred during these meetings.

When asked what they liked, the emergent themes were reinforcement of course concepts in a realistic manner/learning by doing, competition, and fun. Learning themes were the importance of strategy, planning, and contingency planning; application of planning, monitoring and control techniques; impact of poor decisions; need for flexibility; and project management is not easy. Themes related to recommended changes to the simulation were more feedback from the simulation explaining results, more interactive user interface/animation, warning prompt/hints when making bad decisions, and more practice before playing for real. Most students were not project managers but reported applying some of the course concepts to their work on projects and having a better appreciation for the role of a project manager. The dominant themes under what not to change in the course and other comments about the course were to keep the course structure, team assignments, and the simulation game.

Examining the outlier at the less-satisfied end of the scale, one student in the 2021 hybrid cohort was neutral on the preference for hands on learning and slightly disagreed that the simulation should be retained in the course, writing "way too much class time was consumed on simulations. I come to class to learn from my professor and my peers, not to use it as a working period." This student also had a less than ideal team experience noting that when one of the teammates "got fixated on something, he wouldn't listen to others and had to figure it out on his own." The other teammate "was very enjoyable to work with" but "I personally grew impatient with the time spent on fixating, and my ideas not being heard well." This student provided the low outlier attitude scores towards simulations in general (sg2 = 2.5) and this simulation experience (sp2 = 3.6), but surprisingly agreed with the statements in the attitude scale towards teamwork during this simulation (tp2 = 6). Offering a counterpoint to the simulation class time, a different student in the same cohort wrote, "I think it should be done completely in class" to provide the opportunity for more interaction with the professor if there are questions.

DISCUSSION

These results may come as no surprise to faculty accustomed to running their simulation games outside of the classroom; but, for someone accustomed to running the game entirely during classroom time, there is a concern about how students will react to the need to meet as a team outside of class times on a near daily basis for several weeks to discuss results, make decisions for the next round, prepare presentations for the intermediate management reviews, and prepare for the final report/debrief session with the rest of the class and the professor. This study found those concerns were unfounded.

In this case, conducting a live synchronous session with students to learn the game and ask questions, starting the game during a later synchronous session, and completing it between sessions with near daily team interaction was well-received. There was no discernible difference in student satisfaction between the modes and there were no complaints about the workload. One constant in all three modes was live debrief sessions either in the classroom or via web conference for student teams to present their interim status reports and the final team presentations and debrief of results, project audit, and reflections. This study found debriefing the activity was just as effective using a web conference as it was in the classroom.

CONCLUSION

The COVID-19 pandemic required faculty accustomed to conducting their experiential learning activities during live face-to-face classes to adapt their approach to using remote methods that included synchronous web conferences and asynchronous individual assignments and teamwork. While this was nothing new for those teaching their courses using multimodal methods for years, for others it was a new way of providing the experience.

In the case of the program examined in this paper, the professor taught related courses both on campus and online for over a decade but had always taught the course under study on-campus and conducted the simulation game during face-to-face class meetings. This study examined postsimulation student survey data and found no degradation of student satisfaction or learning by

making the change from synchronous face-to-face simulation game activity to remote methods with an asynchronous component to playing the game to returning to a hybrid mode with both face-to-face and asynchronous components. The common characteristic regardless of mode was a live debrief session following the activity, either face-to-face or via web conference.

Limitations of this research are the small sample size, instructor familiarity with remote learning methods, student access to high-speed internet, and the limited modes examined. Only one course was examined per mode and, with access to high-speed internet and web-conferencing familiarity, the professor operated in what might be considered an optimum distance mode environment. Further research is needed to explore the effects of moving from a face-to-face simulation experience to distance modes when faculty have limited online experience and/or students do not have reliable internet access.

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