Resiliency During COVID-19 Disruption: Flipped vs. Traditional Classrooms

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ABSTRACT

We explore the resiliency (i.e., the ability of a system to return to its original state or move to a new desirable state after being disrupted) of traditional lecture-based classes and flipped classes in the face of disruption caused by COVID-19. One flipped class and one traditional lecture-based class, both taught in the Department of Marketing and Supply Chain Management, were selected. For the flipped class, data from the semester prior to and during the pandemic were analyzed, indicating that the flipped class was able to move from face-to-face to online learning with no significant difference in student satisfaction and engagement. Data collected for the traditional lecture-based class indicated significant less student engagement during the transition period from face to face to online learning, but, by the end of the pandemic semester, students had achieved a comparable level of satisfaction and engagement with their online learning environment to students in the flipped class. We conclude that both instructional modalities are resilient, albeit the traditional class had less student engagement when moved online. We suggest that a post COVID-19 policy encouraging faculty to have experience teaching online may be effective in ameliorating future disruptions.

Key Words: COVID-19, Resiliency, flipped classroom

INTRODUCTION

In 2020, the world changed dramatically in just a few months. The spread of the COVID-19 virus impacted all facets of life worldwide. Educational systems in 186 countries had to close their schools forcing over 1.2 billion students and their teachers into learning at a distance (Suprenant, 2020). Following the initial reactions, interest has grown in looking at hard data on the effects of this disruption. In terms of education, the Organization for Economic Cooperation and Development conducted a survey of school systems in 59 countries to understand how this disruption is changing education worldwide. It concluded that the knowledge and experience gained from using various modalities should be systematically collected and evaluated for implementation into the evolving COVID-19 and beyond new normal (Reimers et al., 2020).Similarly, the International Association for the Evaluation of Educational Achievement (IEA) and UNESCO have launched a study, in partnership with the European Commission, to draw a more comprehensive picture of COVID-19's impact on global education. Entitled "Responses to Educational Disruption Survey (REDS)", their aim is to collect information in a systematic, efficient, and scientific manner to determine how teaching and learning were affected by the disruptions and how this was mitigated by the implemented measures, across and within countries. The ultimate objective of the study is to support the development of more open and resilient education systems in the future (UNESCO, 2020).

Resiliency is defined as the ability of a system to return to its original state or move to a new and more desirable state after being disrupted (Behzadi et al, 2017). Robustness, a similar measure, is defined as the ability to withstand disturbances, maintain its original structure, and stay functional in uncertainties (Yoon and Liu, 2010). Resiliency and robustness, though both good attributes, are different concepts and should not be used interchangeably.

Prior to the pandemic, only 29.1% of chief academic officers believed that their faculty accepted the value and legitimacy of online education (Allen et al., 2016). When the pandemic forced virtually all educators to move their in-person classes online, they had to use technology and develop pedagogies they had not used before. It is to their credit that, as faculty gained experience in online teaching, they were able to adapt to the online environment (Wing et al., 2017). While the expectation is that universities will resume in-person classes (Mangan, 2021), an opportunity exists to consider alternatives to the traditional lecture model (Witze, 2020). For example, an article in BBC NEWS asked whether lectures shouldn't be obsolete by now (Pickles, 2016), quoting research showing that students remember as little as 10% of their lecture just days afterward and referencing a Harvard study that found that, on average, attendance at lectures falls from 79% at the start of the term to 43% at the end.

Before the disruption, education was one of the least digitalized and most people-intensive sectors of the economy (Gallagher and Palmer, 2020), so the pandemic is serving as a catalyst for the digital transformation of education. Naturally, there were problems, as many institutions are learning that delivering courses through Zoom or some other digital platform is not proper online learning (Witze, 2020). Dr. Sanjay Sarma, MIT's Vice President for Open Learning, hopes that when universities resume in-person classes, the experience will be radically different. For example, distributing video lectures early to allow faculty to focus on acting as learning coaches and consultants when interacting with students would, according to him, ensure that students understand the concepts being taught (Witze, 2020).

The format described by Dr. Sarma is called blended learning, specifically, a particular form called flipped learning. A blended course is defined as one that has 30-79% of its content online. Academic leaders consistently rate the promise of blended courses as superior to online

courses and at par with face-to-face (f2f) learning (Allen et al., 2016), but academic leaders cannot dictate to faculty how they teach. Academic freedom gives faculty members substantial latitude in deciding how to teach the courses for which they are responsible (Nelson, 2010). The administration can, however, encourage faculty members to adopt a particular teaching modality, through appropriate incentives. Before that can happen, it must be demonstrated that it is for a common good, such as increasing institutional resiliency to future disruption.

The flipped learning instructional modality described by Dr. Sarma's is defined as an educational technique that consists of two parts: interactive group learning activities mediated by the instructor within the classroom, and direct computer-based individual instruction outside the classroom (Bishop & Verleger, 2013). As shown in Figure 1 (Appendix), research about the flipped classroom has grown exponentially (Talbot, 2020). This explosion in knowledge about flipped learning has encouraged its adoption in the classroom. According to the Flipped Learning Global Initiative, by 2017 around 16% of U.S. teachers were flipping their classes, 35% wanted training on how to flip their classes, and 46% of principals wanted new teachers who knew how to flip a class (Noonoo, 2017). And, as can be expected, adoption in the classroom has created a market for flipped products (software, hardware & services) which was valued at $971 in 2018 and is forecasted to grow to $1.9 Billion by 2024 – a compound annual growth rate of 15.5% (AP News, 2019).

The global pandemic caused great disruption and demonstrated that an educational system based on traditional f2f instruction has difficulty moving to online learning after being disrupted (UNESCO, 2020). Future disruptions to the educational system, whether natural or man-made, are unavoidable and will again create a flight to online learning. To prepare for the next disruption, higher education institutions must understand how resilient different teaching modalities were during the COVID-19 pandemic and should take steps to increase the overall number of their classes using the most resilient modality where and when appropriate.

We propose to study resiliency by measuring the change in student engagement and student satisfaction before and after the move to online learning in March 2020. Identifying f2f teaching modalities that incur less disruption when forced to move on-line is a step toward developing the resilient education systems that will be needed in the future.

In the next section, we provide a survey of the pertinent literature to this study to support the development of a set of individual research objectives which individually and collectively will address our overarching research objective: to determine analytically which teaching modality is more resilient to disruption, traditional f2f teaching, or the flipped version of blended learning. The purpose of the research is to give guidance to administrators for incentivizing and encouraging faculty to adopt the most resilient, yet appropriate, teaching modality in their classes when in-person classes resume. This research will augment the limited amount of data-based knowledge currently existent in the literature.

LITERATURE REVIEW

This research posits that when universities return to in-person classes, these classes will either be taught in the traditional f2f format, or as blended classes, both being perceived by academic leaders and faculty alike as being superior to online courses. We also posit that considering the exponential growth in research about flipped learning, it has the potential to become the blended modality of choice. Hence, we begin this section with a review of flipped learning, followed by a review of the theoretical foundation for our work, Michael G. Moore's

Theory of Transactional Distance (2013), and its extensions. We then review the literature supporting our measures of engagement and satisfaction and their relation to outcomes.

Flipped Learning

Authors continue to agree that the basic idea of flipped learning is that class time is used for a learning activity while lecture material is learned outside of the classroom. This is a blended format, using both web resources and face-to-face interactions (Bishop and Verleger, 2013; DeLozier and Rhodes, 2017). The literature suggests that there are as many ways to flip a class as there are instructors attempting to do so. Swart (2017) identified the conscious decisions that an instructor must make to flip a course as follows:

1. Design and develop out-of-class learning and materials.
2. Design the learning space for the in-class Interactive Group Learning (IGL) activities.
3. Design the in-class IGL activities.
4. Achieve effective collaboration between students.
5. Learn how to be a learning coach/consultant (guide by the side instead of sage on stage).
6. Design relevant and appropriate assessments consistent with the flipped learning pedagogy.

Flipped classes grew out of the combination of traditional face-to-face classes with the technological resources that have become available with the growth of the internet (Lage & Platt, 2000). Posting lecture material so it can be studied asynchronously leaves class time for a variety of in-class activities which can foster reflection, questioning, evaluation, and forming connections between ideas (Hockings et al., 2008). Some authors have reported statistically significant improvements in learning outcomes (Swart, 2017) while others find that the students learned at the same level in flipped or traditional classes (Davies, Dean, & Ball, 2013). Flipped learning is transferrable to online courses and yields student satisfaction at par with equivalent f2f flipped courses (Swart and MacLeod, 2020).

Transactional Distance

The Theory of Transactional Distance (Moore, 2013) views transactional distance (TD) as the cognitive, psychological, social, cultural, behavioral, and/or physical distance between learners and the other elements of their learning environment. Zhang (2003) operationalized the theory by defining transactional distance as the barriers to full engagement with their learning environment that students encounter and identified four factors as potential sources for such barriers: The Transactional Distance between Student to Student (TDSS), Student to Content (TDSC), Student to Instructional Technology (TDSI), and Student to Teacher (TDST). Each factor was broken down into several elements and statistically validated for inclusion into the Scale of Transactional Distance. Swart et al. (2014) built on Zhang's Scale of Transactional Distance and collected data on how well a course delivers when compared to an ideal course (a disconfirmation study), which they called the relative proximity. To determine the relative proximity, each Transactional Distance factor is rated twice, once for what the student would have considered an ideal class and once for the delivery of the actual class. The difference

(denoted by Δ) between the two ratings gives us the four relative proximity factors of ΔTDSS (Student and Student), ΔTDSC (Student and Content), ΔTDST (Student and Teacher), ΔTDSI (Student and Instructional Technology). Together, these four factors constitute the Relative Proximity of Transactional Distance (RPTD).

The rapid evolution of computer, communication, and instructional technologies led to a Revised Scale of Transactional Distance (Paul et al., 2015) which had statistical reliability and validity and, consisting of only 12 items, was less cumbersome to administer. However, it was counter-intuitive that the transactional distance of the student to instructional technology was dropped due to lack of statistical validity. Weidlich and Bastiaens, (2018) re-introduced a new transactional distance between students and the instructional technology factor (TDSTECH) consisting of 11 items and expanded the heretofore single dimensional outcome of satisfaction to a multi-dimensional factor consisting of six items. However, they did not have a large enough sample size to validate their instrument. Since then, a large sample statistical analysis allowed modification of that scale by removing items with very low commonalities and/or high Modification Indices. We have dubbed the resulting "best fitting" measurement model RSTD-20 (Revised Scale of Transactional Distance – 2020) and have used it in this paper (see Appendix A).

Student Engagement

Zhang (2003) defined transactional distance as the barriers that students encounter to being fully engaged with their learning environment. Engagement can be impacted by the student's interaction with their fellow student, their teacher, the subject matter being studied, or the instructional technology being employed. Her Scale of Transactional Distance "measures" these impacts and refers to them as Transactional Distances.

Zhang postulated that the transactional distances impacted the student's willingness, need, desire and compulsion to participate in, and be successful in the learning process (Bomia et al., 1997). She reduced these to three outcomes: Student learning, student satisfaction, and student progress. She found that each of these was significantly correlated with Transactional Distance (as Transactional Distance decreased, each outcome increased). These findings were independently verified in several studies (Swart et al., 2014; Paul et al., 2015; Bollinger and Halupa, 2018; Weidlich and Bastiaens, 2018).

Other studies outside of the context of Transactional Distance also corroborate the relationship between student engagement and student satisfaction. Krishen (2013) found a positive association between student engagement and course satisfaction when students felt that course content was meaningful. Evidence showed that student engagement and course satisfaction fully mediated the relationship between lecturer-student exchange and intention to leave university (Farr-Wharton et al., 2018). Unlike "student satisfaction" as an overall attitude or degree of satisfaction, "student engagement" better captures more information on the way teaching is carried out.

Existing literature used the National Survey on Student Engagement (NSSE), a North America survey administered by the NSSE Institute, to assess student engagement (Francescucci and Foster, 2013). Many schools in the United States and Canada participate and use the results to evaluate student engagement on their own campuses (Francescucci & Foster, 2013). This measure includes the student's perception of their engagement on the following six items:

attending class, participating in class, interest in courses, paying attention in class, staying up to date on academic workload, and instructor interaction outside the class.

Student Satisfaction

Student satisfaction is critical in higher education. With online teaching, student satisfaction can be a competitive strategy (Hall et al., 2012). The higher education literature abounds with studies using student satisfaction, measured in various ways. While the Scale of Transactional Distance measures it by a single item (Paul et al., 2015; Swart et al., 2014; Zhang, 2003), others use multiple items (DeShields, Kara & Kaynak, 2005; Gruber et al., 2010; MacLeod et al., 2019; Swart & MacLeod, 2020).

Some researchers ask questions on overall satisfaction and "intention to stay" to measure satisfaction (DeShields, Kara & Kaynak, 2005), or measure satisfaction from evaluative and emotional satisfaction (Brown & Mazzarol, 2009), or even a servicescape approach to develop a new measurement of student satisfaction with higher education services (Gruber et al., 2010). Flipped f2f classes can have greater student satisfaction than traditional f2f classes (Swart & Wuensch, 2016). Consistent with literature on RPTD, our study adopts the RSTD-20 scale to measure student satisfaction using a multi-item scale with six items. This approach reflects the existing literature of measuring student satisfaction using multiple items on overall satisfaction and intention (DeShields, Kara & Kaynak, 2005).

Table 1 (Appendix) provides a summary of the pertinent literature in each of the areas reviewed above in a chronological order. The last row in that table indicates the areas that this paper brings together.

RESEARCH HYPOTHESES DEVELOPMENT

Our overarching research objective is to determine ***analytically*** which teaching modality is more resilient to disruption, traditional f2f teaching, or the flipped version of blended learning. Had we known the pandemic was coming (and when), we would have designed our experiment before the fact. We would have stated our research hypotheses, specified our test statistics, designed our data collection, specified the analysis methodology, and defined the criteria for supporting/rejecting the hypotheses. However, the pandemic was unanticipated and, in the absence of clairvoyancy, no a-priori empirical research design was prepared for this study.

The initial task of the research was to identify sources of data whereby to compare pre-COVID and during COVID student engagement and satisfaction for flipped and for traditional classes. Serendipitously, one instructor in the marketing and supply chain department routinely collected student engagement and satisfaction data in his flipped classes as part of a research study to develop a methodology for continual improvement for his classes (MacLeod and Swart, 2019). This data was appropriate to test for differences in student engagement and satisfaction in flipped classes before and during the pandemic.

No traditional f2f classes were included in the continuous improvement study. We were not able to find any f2f classes for which pre and during COVID-19 student engagement and satisfaction data was available. During the COVID-19 semester, we identified a course that was initially taught as a f2f course but had to convert to an online format when the university shut down. The course was also taught in the marketing and supply chain department and its students were Juniors and Seniors like students who were in the flipped classes. We developed a plan to

collect data which would allow us to assess the resiliency of f2f classes compared to online classes. The plan consisted of administering the RSTD-20 survey to the f2f class toward the end of the COVID-19 semester. This would give us data that reflected student engagement and satisfaction with the online version of their course which was forced on them because of the pandemic. To determine the change in student engagement from the beginning of the semester when the course was f2f and the end of the semester, we administered the National Survey on Student Engagement (NSSE) (Francescucci and Foster, 2013) twice. Initially, we asked students how engaged they felt with the course ***before*** the move to online. The second time, we asked students how engaged they felt with the course ***after*** the move to online.

Figure 2 (Appendix) illustrates the data available from the collection schemes described above. We again emphasize that a-priori knowledge of the occurrence of the pandemic would have lent itself to a more rigorous experimental design. Nevertheless, as we will show, there is useful information to be gained by our a-posteriori analysis.

In Figure 2 (Appendix) we have indicate the research hypotheses we will test during our analysis. These are, with explanation to clarify the purpose when appropriate:

RH1: There is no difference in student satisfaction between the f2f flipped class (pre-COVID-19) and the online flipped class (during COVID 19).

RH2: There is no difference in student engagement between the f2f flipped class (pre-COVID-19) and the online flipped class (during COVID-19).
Explanation: If RH1 And RH2 are supported then there is no difference in student engagement or satisfaction before or during COVID-19, indicating that the flipped classroom was resilient to the accompanying disruption. Data collected for the continual improvement RSTD-20 questionnaire was used to test these two hypotheses.

RH3: There is no difference in student NSSE engagement between the f2f traditional class (pre-COVID-19) and the online traditional class (during COVID-19).
Explanation: If RH3 is supported, then there is no difference in student engagement before or doing COVID-19, indicating that the traditional classroom was resilient on the engagement dimension of resiliency. Data collected from the National Survey of Student Engagement (NSSE) was used to test this hypothesis.

RH4: There is no difference in student satisfaction between the online flipped and online traditional classes (during COVID-19).

RH5: There is no difference in student engagement between the online flipped and online traditional classes (during COVID-19).
Explanation: If RH4 and RH5 are supported, then the levels of student engagement and satisfaction are not significantly different in both online classes. The RSTD-20 questionnaire was administered toward the end of the COVID-19 semester and the data was used to test these two hypotheses.

RESEARCH DESIGN, ANALYSES & RESULTS

Figure 2 (Appendix) described the data that was available or could be collected to test our research hypotheses using the RSTD-20 survey and the NSSE survey as instruments. We had pre and during COVID-19 student engagement and satisfaction data for the flipped classes. We used the NSSE survey to collect pre and during COVID-19 student perception of engagement data in the traditional class. We administered the RSTD-20 survey to both the flipped and traditional classes during COVID-19. This allowed us to compare the NSSE and RSTD-20 student engagement results and check for consistency. This also allowed us to compare traditional class student satisfaction during COVID-19 to that before the pandemic as reported in the literature.

Study Participants

Two required courses in the Bachelor of Business Administration program taught by the Department of Marketing and Supply Chain Management in our university were selected for this study. A Business Analytics course, taught as a flipped class, and an International Marketing class taught as a traditional lecture course. The Business Analytics class was selected because student engagement and satisfaction data using the RSTD-20 survey had been collected pre COVID-19 and during COVID-19 for another study but could be used for this study. The International Marketing class was selected because the instructor was interested in this research. Table 2 (Appendix) exhibits the enrollments by class, gender, and semester. Student participation in the study was voluntary but incentivized via extra credit at the instructor's discretion. Thus, the actual sample size of students varies from the class enrollment for each survey.

Table 2 (Appendix) shows the breakdown of students by gender. However, the small number of females, in the flipped course during the spring of 2020 prompted us to ignore the gender breakdown and treat the sample simply as students, regardless of gender.

Analyses & Results

Research Hypotheses 1&2

To test these hypotheses, we used the data collected with the RSTD-20 survey. This survey collects both student engagement data and student satisfaction with learning data. Research hypotheses 1 & 2 are tested using independent sample t-tests. One run of SPSS 27 allowed us obtain results for both pre/during COVID-19 student engagement and student satisfaction. Hence, we present our results for both under the same heading.

Table 3 (Appendix) exhibits the group statistics for student engagement and student satisfaction for learning. As discussed in the literature section, to test these two hypotheses we use the relative proximity of transactional distance (RPTD) as measures of student engagement and student satisfaction with learning. To measure student engagement, we use ΔTDSC, the relative proximity of the transactional distance between student and course content; ΔTDSS, the relative proximity of the transactional distance between student and student; ΔTDST, the relative proximity of the transactional distance between student and teacher; and ΔTDSTECH, the relative proximity of the transactional distance between student and the instructional technology

used in the course. ΔSatsf.w/Learning measures how close student satisfaction with learning in the course is to ideal.

Table 4 (Appendix) exhibits the results from the independent samples t-test. The use of this test requires independent observations, that the dependent variable follow a normal distribution (if the $n < 25$) and that the standard deviation be equal in both populations (pre and during COVID 19). Levene's test for Equality of Variances provides a test for the latter. Table 4 (Appendix) shows that this test is violated for both ΔTDSC and ΔTDSS. In such cases, conclusions are based on the data provided in the "Equal variances not assumed" rows of the table.

Table 4 (Appendix) show that that there is no significant difference in any of the four RPTD's defining student engagement before COVID-19, when the flipped class was taught face to face, and during COVID-19, when the class was moved online. Thus, RH1 And RH2 are supported. The flipped mode of instruction is resilient in that student engagement and satisfaction were able to return to its original face to face level after being disrupted and moving fully to online learning.

Research Hypothesis 3

No pre COVID-19 data was available for the traditional face to face class. The instructor of this class was familiar with the National Survey of Student Engagement (NSSE), which measures student engagement based on the six factors listed in Table 5 (Appendix) (as opposed to the 4 RPTD factors). This survey was administered to the class twice at the end of the COVID semester. The first-time students were asked to respond about their engagement of the online traditional class, the for the second time, about how they felt when the class was taught face-to-face, before COVID-19. Table 5 (Appendix) exhibits the group statistics. Out of 82 enrolled students, 64 voluntarily responded to the NSSE survey.

The survey data was from Likert scales of the NSSE and hence not continuous. Thus, it was analyzed with SPSS's nonparametric related samples test. For comparison purposes we administered the Related-Samples Sign Test as well as the Related-Samples Wilcoxon Signed Rank Test. The results are exhibited in Table 6 (Appendix). The results indicate that RH3 is not supported for any of the NSSE engagement factors. The traditional face-to-face class was not resilient in that student engagement did not return to its original face-to-face level after being disrupted and moving to fully online learning.

Research Hypothesis 4 & 5

To test these hypotheses, we followed the same process as used to test RH1 and RH2. However, this time we compared student satisfaction and retention in the flipped and traditional classes during COVID, when both had been moved online.

At the end of the Covid-19 semester, students in the traditional class were asked to complete the RTPD-20 survey to determine their satisfaction with learning and engagement. Their results were compared to those of the flipped class. The data so obtained was analyzed with SPSS's independent sample t-test.

Table 7 (Appendix) exhibits the group statistics for student engagement and student satisfaction with learning. Results for the 67 participants from the traditional class are listed in the rows coded as 1 and from the 29 participants from the flipped class are listed in rows coded

as 0. As before, the entries in the "Mean" column of the table are relative proximities and denote how far a particular transactional distance is from ideal. Thus, the smaller the entry, the "better" the result.

Table 8 (Appendix) exhibits the results from the independent samples t-Test for equality of means. Results are given for Levene's Test for Equality of Variances between the data from the flipped and traditional classes. The results indicate that the variances in this data for ΔTDSS and ΔTDST cannot be assumed to be equal ($p<0.05$), thus the results of the test are given in the "Equal variances not assumed" rows of the table. All other results are given in the "equal variances assumed" rows of the table.

The results indicate that there is no significant difference in student satisfaction, as given by ΔSatsf.w/Learng ($p=0.920$), thus RH4 is supported. Student satisfaction in the online flipped cannot be regarded as different than student satisfaction in the online traditional class. Student engagement, as measured by the four relative proximities, differs significantly only for ΔTDST ($p=0.023$). The mean of ΔTDST in the flipped class is 0.515 versus 0.168 for the traditional class indicating that the transactional distance, or engagement, of students with teachers is significantly closer to ideal in the traditional class. Thus, RH5 is partially supported in that students are similarly engaged with the course content (ΔTDSC), their fellow students (ΔTDSS), and the instructional technology (ΔTDSTECH) used in the online version of their courses.

DISCUSSION

The results of our analyses revealed that the flipped classroom is resilient. Based on a statistical comparison of data collected pre COVID-19 (i.e., at the end of the semester before COVID-19) and COVID -19 (i.e., at the end of the semester when COVID-19 struck) when classes were forced online, there was no statistically significant loss in student engagement or satisfaction with learning using RPTD. We attribute those results to the requirement that students in flipped classes had experience with online learning and team collaboration. Students in flipped classes are provided with online video lectures, reading materials, and other web-based resources that must be studied before coming to class. In class, they engage in interactive group learning during which they collaborate in teams to solve a problem that requires an understanding of the assigned out of class materials. The role of the instructor is to coach and consult with groups and provide them with just-in-time information required for them to make progress on their collaborative problem (Swart, 2017). Thus, when the pandemic struck, students were already accustomed to online learning materials. Their principal adjustment was to switch their mutual collaboration and interactions with the instructor from face to face to virtual.

For students enrolled in the traditional lecture-based class, our analyses revealed that students experienced significant loss of engagement on all six dimensions of the National Survey of Student Engagement after their class was forced to go online because of the pandemic. Students were asked about their engagement during the semester that their classes were moved online. This period included when students and teachers had to unexpectedly adjust their teaching and learning to an online format for which they were not prepared. This provides some explanation for the reported loss in engagement in the traditional classes.

The comparison between the online flipped and online traditional classes indicated no significant difference in satisfaction with learning between the two courses. Student engagement was also similar between the two courses except for ΔTDST, the relative proximity of the transactional distance between student and teacher. We attribute the significant difference in

ΔTDST to the different roles that the instructor plays in flipped and traditional learning. In flipped learning, students are not dependent on the instructor to deliver the course information – they must obtain it from web-based materials. Their relationship with the instructor is as a learning coach and consultant. They are not dependent on the instructor as the deliverer of learning, but as the as a learning resource. Thus, they are not engaged with the instructor as students in a traditional course who depend on the instructor as a deliverer of course information as well as a learning resource.

Flipped learning has been reported as providing greater student satisfaction and engagement than traditional modes of instruction (Swart and Wuensch, 2016; Bollinger and Halupa, 2018). Thus, the finding that at the end of the COVID-19 semester the traditional class has similar student satisfaction and engagement to the flipped class is remarkable, considering the results of the NSSE survey. We attribute the findings of the NSSE survey to students having to recall the short term, yet painful disruption of having to move and adjust to online instruction. We attribute the findings of the RPTD-20 survey to its focus on the "here and now" existent at the end of the semester. By that time, both the instructor and students in the traditional class had adjusted to online learning. Furthermore, the shutdown associated with the pandemic provided both students and teachers with little choice but to stay at home and make the best of their new virtual learning environment. By the end of the semester, judging by the results of the RPTD-20 survey, many had adjusted to learning online and become engaged and satisfied with the online version of their course. This satisfies our definition of resiliency – however, at a greater level of disruption than experienced by faculty and students in the flipped course.

CONCLUSION

The two courses used in this study represent the spectrum from quantitative to qualitative courses required in a typical undergraduate marketing program. Thus, we expect these results to be representative of a larger population. Obviously, this study has the limitations that it examined two different courses, two different instructors and utilized two different measurement methods. However, both instructors are experienced and have taught online courses. The pandemic forced the use of available data to address the research questions. While we hope another pandemic does not occur, other disruptions (such as those due to weather events) happen often and represent a future research opportunity.

We chose to address the flipped classroom as an alternative to the traditional lecture-based classroom for the pragmatic reason that, fortuitously, we had pre and post COVID-19 data that had been collected for another purpose but could be used to address our research questions. Flipped learning requires greater use of technology than traditional lecture-based learning. This, we postulated, might make it a more resilient modality when circumstances require classes to move online. These facts provided additional support for our decision to research the resiliency of flipped learning as compared to traditional lecture-based learning.

Our conclusions are that flipped learning is more resilient in terms of impacting student engagement and satisfaction during a time when the class must be moved from face-to-face to online. We found that students in the flipped classroom were equally engaged before and after the transition to online. However, we recognize that not all classes may be suited for flipped learning. Our results found that students in face-to-face lecture-based classrooms experienced disruption when making the transition to online. However, their satisfaction with the online course by the end of the semester was comparable to that of students in the flipped course. This

leads us to believe that the disruption was caused by unfamiliarity with the online technology and the lack of online teaching materials at the time of disruption. Both issues appear to have been addressed during the two-month period between the switch to online and the end of the semester. Thus, we recommend that to minimize disruptions in the future, whether natural or man-made, institutions of higher learning should train ALL faculty to be effective online teachers and require that every class that they teach face-to-face should also be taught online, maybe in alternate semesters. In this way, the class is always prepped for both delivery formats. To the extent possible, flipped learning should be encouraged since our results indicate it being more resilient and less disruptive than traditional lecture-based learning should a delivery modality be required.

LIMITATIONS

This research is limited by the data available to conduct the analyses. The results were obtained from two required courses taught in the Department of Marketing and Supply Chain Management and the results may not be generalizable to courses in other disciplines. Level of faculty experience was not the focus of this study. Future research can examine if experienced versus junior faculty have similar results on student engagement and satisfaction.

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APPENDIX A: REVISED SCALE OF TRANSACTIONAL DISTANCE - 2020

TD FACTOR	TD ELEMENT	ELEMENT DESCRIPTION
TDSC		
	TDSC1	This course emphasized SYNTHESIZING and organizing ideas, information, or experiences.
	TDSC2	This course emphasized MAKING JUDGEMENTS about the value of information, arguments, or methods.
	TDSC3	This course emphasized APPLYING theories,and concepts to practical problems or in new situations.
TDSS		
	TDSS1	I get along well with my classmates.
	TDSS2	I feel valued by class members in this class.
	TDSS3	My classmates in this class value my ideas and opinions highly.
	TDSS4	My classmates respect me in this class.
	TDSS5	The class members are supportive of my ability to make my own decisions.
TDST		
	TDST1	I receive prompt feedback from the instructor on my academic performance.
	TDST2	The instructor was helpful to me.
	TDST3	The instructor can be turned to when I need help in the course.
TDSTECH		
	TDSTECH1	I experienced frustration using the instructional technology available in the course.
	TDSTECH2	I had to consciously think about how to use the instructional technology available in the course.
	TDSTECH3	I find it pleasant to use the instructional technology available in the course.
OUTCOMES		
Satisf/L		
	Satisf/L1	I benefited from this course.
	Satisf/L2	This course met my expectations.
	Satisf/L3	I experienced and learned new things in this course.
	Satisf/L4	The content covered in this course was NOT interesting.
	Satisf/L5	I would like to take more courses like this one.
	Satisf/L6	I wish other courses were more like this one.

Table 1. Select previous research related to transactional distances and student learning

Study	Transacional Distances	Flipped Learning	Student Learning	Key Findings
Bormia, et al. (1997)			✓	• Student engagement is defined.
Lage & Platt (2000)		✓		• A web site consisting of four sections is a main part of the "inverted classroom."
Zhang (2003)	✓	✓	✓	• Using the Theory of Transactional Distance, TD is defined for an online environment and four factors are measured.
Hockings, et al. (2008)			✓	• This study explores the conditions of student engagement or disengagement among computing students at two universities.
Brown & Mazzarol (2009)			✓	• Student perceived image of the host university predicts student satisfaction, which further predicts student loyalty.
Gruber et al. (2010)			✓	• Student satisfaction reflects students' perceived quality differences of offered services and environment.
Hall et al. (2012)			✓	• Student satisfaction is important as it can be a competitive strategy.
Moore (2013)	✓			• The theory of transactional distance is redefining the discipline of adult education.
Bishop & Verleger (2013)		✓	✓	• The flipped classroom offers a new pedagogical method for education research.
Davies, Dean, & Ball (2013)		✓	✓	• A technology enhanced flipped classroom is effective.
Francescucci & Foster (2013)			✓	• NSSE can be used to measure student engagement.
Krishen (2013)			✓	• There is a positive link between student engagement and course satisfaction when students feel that course content is meaningful.
Swart, et al. (2014)	✓	✓	✓	• Relative Proximity Theory can be used to measure the gap between actual and ideal online course results.
Paul, et al. (2015)	✓	✓	✓	• A revised Scale of Transactional Distance significantly predicts student satisfaction.
DeLozier & Rhodes (2017)		✓		• Flipped learning is made up of a learning activity in-the-class and lecture material outside-of-class.
Swart (2017)	✓	✓	✓	• There are emerging research opportunities in extending the principles of flipped learning.
Bolliger & Halupa (2018)	✓		✓	• Transactional distance is a valid predictor of student engagement.
Farr-Wharton, et al. (2018)			✓	• Student engagement and satisfaction mediate the link between lecture-student exchange and intention to leave university.
Weidlich & Bastiaens (2018)	✓	✓	✓	• A new TD factor, TDSTECH, with 11 elements is introduced. • Student satisfaction is extended from one dimension to multiple dimensions.
Bowden, Tickle & Naumann (2019)			✓	• Student engagement can have different orientations.
MacLeod, et al. (2019)	✓	✓	✓	• Relative Proximity Theory is helpful to explain a continual improvement of online and blended teaching.
Swart, et al. (2020)	✓	✓	✓	• There is no significant difference in student satisfaction between the online and face-to-face flipped learning classes.
The current paper	✓	✓	✓	•Flipped learning tends to have resiliency during COVID-19.

Table 2. Course enrollments

	Flipped Courses		Traditional Course
	Fall 2019	Spring 2020	Spring 2020
Male	33	21	47
Female	18	8	35
Total	51	29	82

Table 3. Engagement and Satisfaction Group Statistics

2020 (Y=1)		N	Mean	Std. Deviation	Std. Error Mean
ΔTDSC	1	29	0.207	0.523	0.097
	0	40	0.042	0.241	0.038
ΔTDSS	1	29	0.200	0.526	0.098
	0	40	0.090	0.293	0.046
ΔTDST	1	29	0.517	0.754	0.140
	0	40	0.350	0.758	0.120
ΔTDSTECH	1	29	0.299	0.818	0.152
	0	40	0.458	0.707	0.112
ΔSatisf.w/Learning	1	29	0.345	0.678	0.126
	0	40	0.321	0.625	0.099

Table 4. Independent Samples t-Test Flipped Class Engagement and Satisfaction pre/during COVID-19

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
ΔTDSC	Equal variances assumed	10.900	0.002	1.761	67	0.083	0.165	0.094
	Equal variances not assumed			1.585	36.669	0.122	0.165	0.104
ΔTDSS	Equal variances assumed	4.826	0.031	1.107	67	0.272	0.110	0.099
	Equal variances not assumed			1.017	40.550	0.315	0.110	0.108
ΔTDST	Equal variances assumed	0.520	0.473	0.906	67	0.368	0.167	0.184
	Equal variances not assumed			0.907	60.708	0.368	0.167	0.184
ΔTDSTECH	Equal variances assumed	0.004	0.950	-0.866	67	0.390	-0.159	0.184
	Equal variances not assumed			-0.846	54.950	0.401	-0.159	0.189
ΔSatisf.w/Learning	Equal variances assumed	0.055	0.815	0.152	67	0.880	0.024	0.158
	Equal variances not assumed			0.150	57.459	0.881	0.024	0.160

Table 5. NSSE Engagement Group Statistics

pre COVID(=1)		N	Mean	Std. Deviation	Std. Error Mean
Attendance	0	64	2.14	1.296	0.162
	1	64	1.09	0.294	0.037
Participation	0	64	2.44	1.283	0.160
	1	64	1.64	0.824	0.103
Interest	0	64	2.52	1.285	0.161
	1	64	1.64	0.880	0.110
Paying Attention	0	64	2.38	1.254	0.157
	1	64	1.45	0.665	0.083
Stay Updated	0	64	1.61	0.847	0.106
	1	64	1.16	0.366	0.046
Instructor Interaction	0	64	2.77	1.423	0.178
	1	64	2.50	1.425	0.178

Table 6. Results of Nonparametric Related Samples Tests

Mediam of differences between:	Related-Samples Sign Test	Related-Samples Wilcoxon Signed Rank Test	Decision
Attendance	0.000	0.000	Reject H3
Participation	0.045	0.006	Reject H3
Interest	0.000	0.000	Reject H3
Paying Attention	0.000	0.000	Reject H3
Stay Updated	0.000	0.000	Reject H3
Instructor Interaction	0.006	0.001	Reject H3

Table 7. Satisfaction and Engagement Group Statistics

Traditional class =1		N	Mean	Std. Deviation	Std. Error Mean
ΔTDSC	1	67	0.323	0.789	0.096
	0	29	0.207	0.523	0.097
ΔTDSS	1	67	0.134	0.324	0.040
	0	29	0.200	0.526	0.098
ΔTDST	1	67	0.168	0.375	0.046
	0	29	0.517	0.754	0.140
ΔTDSTECH	1	67	0.308	0.859	0.105
	0	29	0.299	0.818	0.152
ΔSatisf.w/Learning	1	67	0.361	0.725	0.089
	0	29	0.345	0.678	0.126

Table 8. Independent Samples t-Test Flipped vs. Traditional Class Engagement and Satisfaction during COVID-19

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
ΔTDSC	Equal variances assumed	2.187	0.143	0.728	94	0.469	0.116	0.160
	Equal variances not assumed			0.852	78.220	0.397	0.116	0.137
ΔTDSS	Equal variances assumed	3.975	0.049	-0.748	94	0.456	-0.066	0.088
	Equal variances not assumed			-0.623	37.482	0.537	-0.066	0.105
ΔTDST	Equal variances assumed	21.294	0.000	-3.035	94	0.003	-0.349	0.115
	Equal variances not assumed			-2.372	34.166	0.023	-0.349	0.147
ΔTDSTECH	Equal variances assumed	0.003	0.958	0.051	94	0.959	0.010	0.188
	Equal variances not assumed			0.052	55.731	0.959	0.010	0.185
ΔSatisf.w/Learning	Equal variances assumed	0.071	0.790	0.100	94	0.920	0.016	0.158
	Equal variances not assumed			0.103	56.662	0.918	0.016	0.154

Figure 1: Published Research on Flipped Learning (# of peer-reviewed articles)

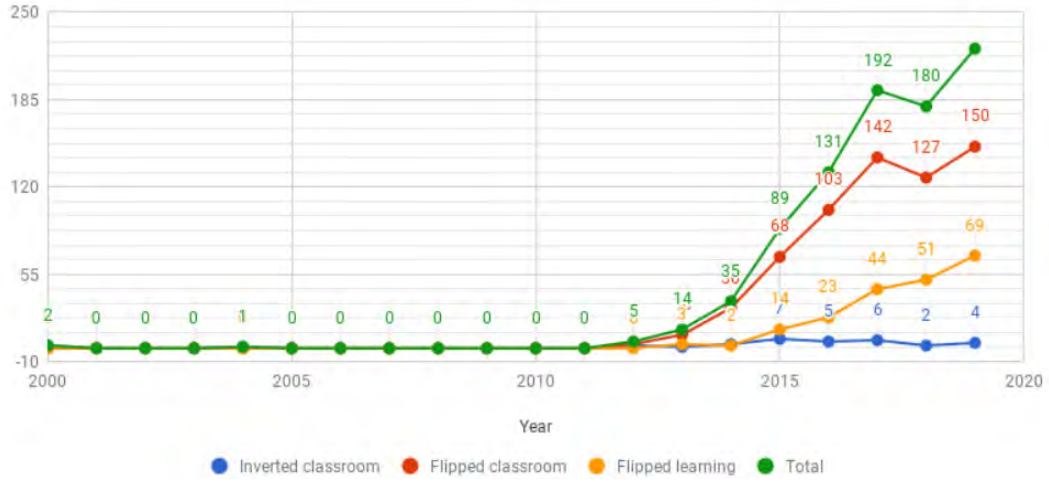

Figure 2: Data Sources and Research Hypotheses