Journal of Information Systems Education

Volume 35
Issue 1
Winter 2024

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Darryl Romanow, Melinda K. Cline, and Nannette P. Napier

Recommended Citation: Romanow, D., Cline, M. K., & Napier, N. P. (2024). A Response to COVID: From Traditional to Remote Learning Using a Flipped Classroom Pedagogy and Its Impact on BI Skills Attainment. *Journal of Information Systems Education*, 35(1), 99-111. https://doi.org/10.62273/NOBF5942

Article Link: https://jise.org/Volume35/n1/JISE2024v35n1pp99-111.html

Received:	December 28, 2022
First Decision:	February 13, 2023
Accepted:	May 13, 2023
Published:	March 15, 2024

ISSN: 2574-3872 (Online) 1055-3096 (Print)

Journal of Information Systems Education, 35(1), 99-111, Winter 2024
https://doi.org/10.62273/NOBF5942

A Response to COVID: From Traditional to Remote Learning Using a Flipped Classroom Pedagogy and Its Impact on BI Skills Attainment

Darryl Romanow
Melinda K. Cline
School of Business
Georgia Gwinnett College
Lawrenceville, GA 30043, USA
dromanow1@ggc.edu, mcline@ggc.edu

Nannette P. Napier
Robinson College of Business
Georgia State University
Atlanta, GA 30303, USA
nnapier1@gsu.edu

ABSTRACT

The COVID-19 pandemic dramatically impacted the global post-secondary education environment beginning March 2020, leaving many classes using the traditional face-to-face delivery method scrambling to adapt. This paper describes the process used in response to COVID to convert a traditional lecture-style business intelligence class to a flipped classroom, while maintaining assignments, groups, and discussion as student engagement techniques. End of term skills assessments of four pre-COVID sections are combined with skills assessments from two during-COVID flipped online sections. The during-COVID sections use pre-recorded Kaltura video lectures, supplemented with Blackboard Collaborate virtual meetings, in a flipped online delivery approach. Partial least squares (PLS) regression results indicate a flipped approach augments other student engagement methods and significantly improves skills attainment. Results also indicate that while group formation continues to enhance in-class assignment completion and reflection, discussion is less impactful in an online environment. This research highlights nuances of business intelligence education and provides suggestions for enhancing approaches for improved skills attainment.

Keywords: Active learning, Discussion, COVID-19, Flipped classroom, Groups

1. INTRODUCTION

COVID-19 disrupted research, teaching, and learning in higher education, forcing a rapid response and, in some cases, drastic changes to course delivery. Converting face-to-face delivery to online learning is one such change (Ling & Ling, 2020). This paper discusses how an undergraduate business intelligence (BI) course is adapted to shift the learning environment from face-to-face to synchronous online in response to the COVID-19 pandemic. This study complements the work of others in higher education who have discussed their experiences transitioning technology-based courses online (Singh et al., 2022; Williams & Elmore, 2021).

Even prior to COVID, there was an increasing demand for professionals skilled in Data Science and Analytics (DSA), including Big Data, data analytics, and Business Intelligence (BI) (Fenlon & Fitzgerald, 2017). Recent reports indicate that the "Best job in America" is a Data Scientist, with an average salary of $108,000, high job satisfaction, and many openings (Fottrell, 2019). As employer demand for BI skills increases (Anand, 2022; Fottrell, 2019), the motivation to understand the optimal approaches to teach BI skills also intensifies.

Prior to the pandemic, the course in this study was taught exclusively using a face-to-face delivery method with limited use of online instructional technologies such as video conferencing, lecture capture, and remote test proctoring. In-class lectures introduce material then reinforce the material presented using an active learning pedagogical approach (Riordan et al., 2017; Stefanou et al., 2012; Strayer et al., 2019). Students discuss and apply concepts and tools in class in pre-assigned groups. For the initial two-thirds of each semester, students build their proficiency with BI tools including table joins, data transformation through Data Analysis Expressions (DAX) commands, data visualization using Power View/Power BI dashboards, and data analytics through partial least squares (PLS) regression. Each week, students complete in class and/or homework assignments to reinforce and extend their skill levels. These exercises typically incorporate real-world data

downloads from government websites or teaching cases with an authentic business context (Napier, 2018). During the last third of the semester, students apply what they have learned to complete a Data Challenge project. Romanow et al. (2020) describe progressive improvements to this BI course over four semesters (Spring 2017, Summer 2017, Fall 2017, Spring 2018). The pre-COVID student engagement techniques include frequent in-class assignments, group formation, and discussion.

In Spring 2020, the BI course began as usual but, by early March, it was evident COVID-19 would disrupt face-to-face instruction. On March 10, 2020 the School of Business organized an emergency training session for faculty that included two online instructional technologies: (i) Kaltura to record online lectures and (ii) Blackboard Collaborate for synchronous online collaboration. These tools were integrated into the learning management system (D2L) and adopted by many business school faculty. In-person classes were suspended the following week, and faculty scrambled to acclimate to the new online environment. During the course adaptation process, the instructor introduced the flipped learning pedagogical approach (Swart & MacLeod, 2020), while maintaining the assignments, groups, and class discussions. Due to the mixed modality of Spring 2020, data from this semester is excluded from this study. During-COVID data is included in this study and is from the Fall 2020 and Spring 2021 semesters.

This paper is unique and provides an important contribution to the existing literature by describing a rigorous empirical longitudinal analysis of BI skills attainment across pre- and during-COVID environments. It describes how the flipped learning pedagogical approach facilitates the shift to emergency remote teaching (ERT), which refers to the rapid change from face-to-face to online teaching and learning (Hodges et al., 2020). The during-COVID semesters studied in this paper occur at a time when masks are mandated, vaccines are not yet widely available, social distancing is required, and both parents and students are reluctant to gather in public settings. We examine the shift to ERT using the following research questions:

- RQ1: What student engagement techniques are effective for BI skills attainment?
- RQ2: How does adopting a flipped learning pedagogical approach during ERT affect BI skills achievement?

In the remaining sections of this paper, we present the relevant literature, describe our focal BI course, and summarize how it was adapted in response to the pandemic. We then introduce the research model, share empirical results, and analyze our findings. We conclude with lessons learned and suggestions for further study.

2. LITERATURE REVIEW

In this section, we discuss the three student engagement techniques used to meet the course objectives: in-class assignments, group formation and discussion. We then describe the contrasting pedagogical approaches used in the class before and during the pandemic. Before COVID focuses on in-class lecture with active learning; during COVID, changes to a flipped learning approach with continued use of in-class assignments, group formation and discussion techniques.

2.1 Student Engagement Techniques

In-class assignments actively engage students in the learning process while the teacher and peers are available to provide support. Such engagement by design activities is fundamental to active learning. In the course, students individually and collaboratively select large datasets (Anderson et al., 2014); extract, transform, and load (ETL) data into data models (Chiang et al., 2012); analyze data, create dashboards, and consider the strategic use of BI applications (Gupta et al., 2015); and communicate their findings orally and in writing (Anderson et al., 2014). Incorporating these problem-solving activities helps students achieve higher-order thinking and an open and relaxed environment reduces barriers to learning (Riordan et al., 2017).

Group formation allows students to engage in collaborative and cooperative learning (Johnson et al., 1998; Prince, 2004; Strayer et al., 2019). In collaborative learning, student work is evaluated in small groups, whereas in cooperative learning students are evaluated individually (Johnson et al., 1998; Prince, 2004). These approaches include incentives to promote social learning rather than competitive and individualistic learning (Prince, 2004; Strayer et al., 2019). Studies indicate teamwork, both collaborative and cooperative, enhances student motivation (Dadach, 2013) and increases student achievement (Johnson & Johnson, 1989). Students in high-collaboration teams are typically also more satisfied with their learning experience than those in low-collaboration teams (Napier & Johnson, 2007). This focus on teamwork is especially important within the information systems (IS) discipline. Topi (2019) describes IS as a collaborating discipline in which collaboration and teamwork are core competencies for IS education. In addition to technical skills, Wixom et al. (2014) found that communication is a highly desired skill sought by employers when making BI/BA hiring decisions. BI courses help students develop both technical and communication skills by teaching them to become data-driven decision makers in a collaborative environment (Jeyaraj, 2019).

Communication skills are further developed in this course using discussion as an additional student engagement technique. Discussion supports the development of communication skills and has been effectively used in both traditional and online courses (Brookfield & Preskill, 2005). Discussion has several benefits. For example, Goh et al. (2020) found that adding an online question and answer discussion before team-based exercises enhances both student engagement and content comprehension. Discussion has also been found to promote an enriched understanding across class participants (Eeds & Wells, 1991), helping them learn new concepts and preparing them for independent learning (Mercer & Howe, 2012). Discussion prompts students to reflect on what they are learning, maximizing the inherent benefits (Lewis & Williams, 1994). Although described as important for student learning, discussion has been an underutilized technique in the classroom (Mercer & Howe, 2012).

2.2 Contrasting Pedagogical Approaches

As discussed in the prior section, to facilitate student learning before the pandemic, the instructor utilizes an active learning approach. Once it became necessary to transition the course online, the instructor adopts a flipped learning pedagogical approach while continuing to include the in-class assignment, group formation and discussion student engagement activities.

Learning to collaborate effectively in a team environment is enhanced by active learning pedagogies (Conduit et al., 2017), while active learning engages students in the learning process (Prince, 2004).

The flipped learning pedagogical approach facilitates increased collaboration time during class by moving the lecture portion outside of class time. It is a blended learning instructional strategy (Rasheed et al., 2020) in which the initial presentation of material is done prior to class, and class time is used to synthesize and apply the subject matter (Olitsky & Cosgrove, 2016). Using this approach, students receive in-class individual learning assignments that replace the lecture component of classroom instruction. Time allocated during class is focused on applied activities that involve collaboration and interaction (Mok, 2014). A meta-analysis of the literature performed by Strelan et al. (2020) shows the flipped classroom approach has a moderate positive effect on student performance due to the opportunity for students to engage in structured, student engagement activities and problem solving. Swart and MacLeod (2020) find that the flipped learning pedagogical approach is effective for online analytics courses, yielding equivalent student satisfaction scores when compared to face-to-face flipped courses.

Van Alten et al. (2019) studied 114 meta-analysis that focus on the effects of Flipped Learning on learning outcomes and student satisfaction, and document mixed results. While a flipped approach is associated with a small positive impact on learning assessments, student satisfaction and perceived learning outcomes are not significant. Positive and significant learning assessments are found in contexts in which quizzes precede a short summary lecture, followed by active learning exercises (Van Alten et al., 2019).

Ezeh et al. (2023) conducted a meta-analysis on the literature focused on the impact of flipped learning on learning outcomes in college level STEM classes. Again, they find mixed results, with some studies reporting no statistical differences between traditional face-to-face and flipped modalities, while other meta-analysis demonstrating statistically significant improvements with a flipped approach (Ezeh et al., 2023). Positive outcomes associated with a flipped approach favor contexts in which pre-class video lectures are made available to students with pre-class assignments then reinforced by collaborative in class activities (Ezeh et al., 2023).

3. BI Course

In this section, we provide more detail about the BI course that is the focus of this study. We begin by describing the course fundamentals, which remain constant throughout all six semesters of the study: major topics, software used, and major assessments. The next sections describe the pre-COVID in-person course design, the Spring 2020 shift to ERT, and the during-COVID online flipped course design.

3.1 Course Fundamentals

3.1.1 Overview. The BI course is required for students seeking a Bachelor of Business Administration (BBA) degree with a concentration in Management Information Systems (MIS) and for students earning the Business Intelligence for Managers certificate. This junior-level course is designed to be an accessible elective for all business majors and is popular among students in the Supply Chain Management concentration. Course topics include big data, technology changes enabling BI, reports and visual analytics including data warehousing, BI front-end tools, data analytics, and data quality. These topics are consistent with the suggested four pillars of analytics curriculum: data preprocessing, storage, and retrieval; data exploration; analytical models and algorithms; and data product (Kang et al., 2015).

3.1.2 Software Tools. Faculty considered software capability, ease of use, availability, and cost to determine which software to incorporate in the course. Since the introductory course in MIS is a prerequisite, students who enroll in the course are expected to have at least intermediate level MS Excel skills. Some students also have novice-level SQL database skills and may have completed additional undergraduate technical coursework.

The three primary software tools used in this course are Power Pivot, Power BI, and Smart PLS 2.0. Power Pivot is an Excel add-on used to transform data into data models. While the functionality mirrors the capabilities contained in MS Access, the MS Excel extension eliminates the need to import data in and out of Access to share data, charts, and graphs with colleagues. Power BI provides dashboard functionality to support the creation of multiple visualizations using Excel data. Pre-COVID, the dashboard visualization tool used was Power View, an Excel add-on that allows students to build on their existing knowledge of spreadsheet software. As this product was discontinued in 2021, the course was changed during COVID to use Power BI Desktop, a free download that offers expanded functionality. Figure 1 provides an illustration of a dashboard created by a supply chain management student using the Power BI desktop tool. Smart PLS 2.0 was a free, regression-based structural equation modelling (SEM) software that combines an intuitive visual interface with robust bootstrapping capabilities. It is well suited for exploratory research (Hair et al., 2019). It is particularly useful for big data applications that focus on prediction, require complex models, and have less emphasis on theory confirmation (Rigdon et al., 2017). These three tools provide students with a cohesive skillset for BI analysis that they can continue to use both in the classroom and in the workplace.

Figure 1. Power BI Desktop Dashboard

3.1.3 Major Assessments. Major assessments in the course consist of two exams, 14-20 in-class assignments (ICAs), homework assignments, and a Data Challenge final project. Exams have both a conceptual and application piece. On the conceptual part, students answer multiple choice and short answer questions on topics. On the application component, students are given a sample data set to analyze using one of the software tools. ICAs frequently feature step-by-step directions on how to complete tasks within the BI software tools. Between 30-45 minutes of each class is dedicated to providing additional practice for students to reinforce skills or introduce new topics that will be further covered in class.

The Data Challenge is the culminating assignment of the BI course and requires students to apply all of the skills they have learned in a new context. The assignment is designed as a co-operative learning experience with significant individual components required before students work with a partner (Riordan et al., 2017; Stefanou et al., 2012). Working as "citizen data scientists" (Gartner, 2017), students independently research questions of interest, find relevant publicly available data sets, create a data dictionary table, and perform data transformations. Following are two examples of students' research questions and data sources:

- Does university level average family income, family financial aid, and average incoming SAT scores predict ten-year alumni salaries? Data sources: US Department of Education College Scorecard
- Is there is a correlation between the number of COVID vaccinations administered in the country, the country's GDP, and the number of Internet users in the country? Data sources: https://www.kaggle.com/gpreda/covid-world-vaccination-progress

During the final weeks of class, students, in pairs, combine their research questions and data into a single research project, prepare a final summary report, and present findings in a six-to-eight-minute presentation.

3.2 Pre-COVID Course Design

The original design of the BI course is face-to-face, in-person instruction. Over the course of four semesters (Spring 2017, Summer 2017, Fall 2017, and Spring 2018), the instructor develops numerous "engagement by design" elements (Riordan et al., 2017) in response to student feedback and the instructor's desire to improve student learning. As summarized in Table 1, the progressive implementation of course design elements include the introduction of classroom discussion, the formation of semester-long teams, and adjusting the number of ICAs. Over the six semesters, more than 95% of the students who registered completed the course, and their results are included in our analysis.

Spring 2017 is a baseline for the course design. The instructor lectures and introduces skills during class time. Students are assigned individual, in-class assignments to practice their skills. There is no deliberate focus on incorporating peer-to-peer interaction via discussion or teams. If students have questions, they primarily seek assistance from the instructor or occasionally ask the person sitting next to them for help. This one-on-one approach limits the number of students that can reasonably be helped solely by the instructor during the class period, leaving some students frustrated.

#	Term	DISC	Teams	Flipped	Class Size	# of ICAs
Pre-COVID, In-Person, Lecture, ICA release after lecture						
1	Spr 2017	No	No	No	35	14
2	Su 2017	Yes	No	No	12	14
3	Fall 2017	Yes	Yes	No	28	17
4	Spr 2018	Yes	Yes	No	33	20
During-COVID, Online, Kaltura video lecture, early release of ICA						
5	Fall 2020	Yes	Yes	Yes	32	17
6	Spr 2021	No	Yes	Yes	31	17

Table 1. BI Course Engagement by Design Techniques

In Summer 2017, the instructor adds full-class discussion as an additional way of actively engaging students and requiring them to reflect on their learning. This approach is adapted from the Brookfield and Preskill (2005) book Discussion as a Way of Teaching. Sometimes students are asked broad questions about the course (e.g., "What did we discuss last week?"); other times, discussion questions are more focused (e.g., "What did you learn from the assignment that stuck out to you?"). While working on the Data Challenge, students are encouraged to share their group's progress, as well as any challenges encountered. The class actively engages as a whole to improve the evolving projects. Since the class size decreases from 35 in Spring 2017 to 12 in Summer 2017, the instructor is able to adopt a seminar style, often arranging seats in a circle to facilitate communication. Students then have an opportunity to use BI jargon in a supportive environment and to reinforce their own learning while helping others.

During Fall 2017 and Spring 2018, an increase in class size renders the seminar style impractical; however, the instructor still wants the students to have the benefits of group discussion. To accomplish this, team formation is added to the course design. Based on guidance from Brookfield and Preskill (2005) on creative grouping, students are assigned to four or five person teams based upon their technology skillset. During the first day of class, students assess their knowledge of several technologies used in the class: PowerPivot, Power View, infographics, SQL, and Access. The instructor then forms teams with a mixture of high and low skillsets. These semester-long teams are used in multiple ways during class time. For example, the instructor asks students to break into their teams to discuss concepts and issues for several minutes, then the class reconvenes to engage in a broader discussion. Students completing in-class assignments (ICA) and the Data Challenge project are able to turn to team members for assistance rather than relying solely on the instructor. As a consequence of incorporating this approach, the instructor is able to cover additional material and to introduce three new ICAs.

3.3 COVID-19 Transition

In March 2020 the campus abruptly ceased face-to-face instruction for the remainder of the Spring semester in response

to the COVID-19 pandemic. For many students and faculty at the institution, this became their first exposure to online instruction and learning. During the ERT faculty rapidly learn to use and incorporate software tools into their courses to support online learning. Collaboration software (MS Teams), synchronous web-conferencing tools (Blackboard Collaborate), and lecture capture software (Kaltura) are the tools that were available and these are new to most faculty at this institution. To complete the semester, during a 3-week institution-wide preparation period, the instructor prepares the remaining lectures using Kaltura, a tool integrated into the class Learning Management System (LMS) Desire to Learn (D2L). Since the class delivery method is fractured mid-term, Spring 2020 student performance results are not included in this study's empirical analysis.

3.4 During-COVID Course Design

By Fall 2020, the institution begins offering more courses with some in-person component; however, the BI course continues to be taught synchronously online. For the instructor, this causes a reconsideration of which pedagogical techniques have the potential to be most effective with the new online course delivery method. The during-COVID course design is fully developed and implemented by Fall 2020, most elements of the course remaining unchanged. Team formation continues as a peer-to-peer engagement strategy. Homework assignments and the Data Challenge continue as in previous semesters. Online discussion continues during Fall 2020, but since students opt to mute their microphones and cameras, it is abandoned in Spring 2021.

The largest change begins in Fall 2020 and is the adoption of a flipped learning pedagogy. This significantly increases the preparation students must do prior to class. Students are expected to watch a Kaltura video and review slides in lieu of an instructor's lecture. Often, they are also given a sample data set to supplement the homework exercise to practice the skills presented. One day before class, the ICA is opened by the instructor via the course's learning management system (LMS). Students then have the opportunity to review the next day's ICA ahead of time and identify any questions they have.

During the synchronous online portion of the class, the instructor begins with a 15-20 minute overview of common assignment issues from the prior week, reviewing concepts, and answering questions. Students then meet in online breakout groups using a collaboration tool (MS Teams, Zoom, etc.) to complete the ICA. Students who complete their ICA before class are encouraged to help others in the group. Attendance is required for students to receive a grade for the ICA. During the group breakout time, the instructor remains available for consultation within Blackboard Collaborate, but groups are encouraged to solve problems on their own. Students rejoin the entire class at a time set by the instructor.

4. RESEARCH MODEL

The research model indicates the investigated impact of structured group formation (GRP), during-COVID flipped classroom design (videos prior to class-time), active learning in-class assignments (ICA), and in-class discussion (DISC) on student skills attainment. Student completion of homework assignments (HMWK) is used as a control. Construct definitions and informing sources are outlined in Table 2. Figure 2 provides an overview illustration of the research model. We hypothesize that each of the student engagement techniques and the flipped approach will impart a positive effect on SKILLS.

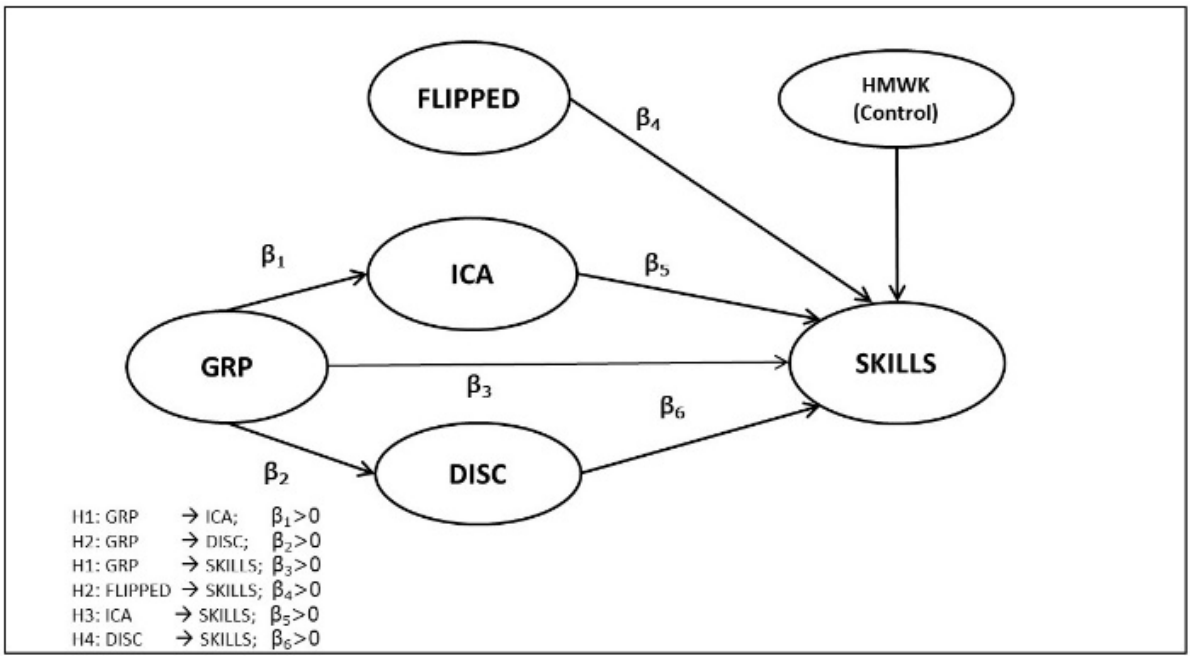

Figure 2. Research Model

Construct	Acronym	Measures	Informing Sources
Team Formation	GRP	Full semester group formation shifting focus from instructor to the group for assistance during ICAs • Binary score of 0 or 1	Active learning in small groups (Brookfield & Preskill, 2005; Conduit et al., 2017)
In Class Assignments	ICA	Sum of successful individual level cooperative and/or collaborative ICAs • Total # assignments completed	Active learning (Prince, 2004; Riordan et al., 2017; Romanow et al., 2020; Strayer et al., 2019)
Discussion	DISC	Group reflective discussion on assigned topics to reinforce key BI learning covered in prior week ICAs • Binary score of 0 or 1	Reflective discussion to improve comprehension (Brookfield & Preskill, 2005; Dudley-Marling, 2013; Goh et al., 2020)
Homework Assignments	HMWK	Sum of individual level homework assignments completed • Total # assignments completed	Traditional pedagogical approach (Control)
BI Skills	SKILLS	Formed by 3 BI skills total score 0-3 Primary table joined with two or more tables = 1 One join = 0.5 No joins = 0 Four or more visualizations = 1. Two charts = 0.5 PLS-SEM regression with significance. NS = 0.5	Business intelligence pillars of analytics learning categories (Kang et al., 2015; Mills et al., 2016).
Flipped Classroom	FLIPPED	Remote learning post-COVID Kaltura video lectures introduce new skills a priori. Active learning in class exercises enabled by Blackboard Collaborate • Binary score of 0 or 1	Instructional material is delivered prior to class (Olitsky & Cosgrove, 2016; Rasheed et al., 2020)

Table 2. Independent and Dependent Variables

4.1 Dependent Variable

The dependent variable for this study is BI Skills (SKILLS). End of term assessment of SKILLS is captured through three distinct BI capabilities as demonstrated in their final data challenge report. Each student is rated on a score from zero to three based on the following skills:

- Capability 1: Demonstration of two or more table joins, and use of the related command;
- Capability 2: A Power View / Power BI desktop dashboard which incorporates four or more visualizations, background changes, text boxes; and,
- Capability 3: Use of Smart PLS structural equation modeling (SEM) to demonstrate and then articulate meaningful and significant associations across their chosen data sets.

Capability 1 requires students to join tables in a Power Pivot model using one primary and two or more secondary tables. Creating a data model that utilizes relational database techniques is a primary BI skill. Capability 1 for each data challenge submission is scored as a zero, 0.5, or 1. To evaluate a successful table join, the instructor uses diagram view to ensure the key fields match data types, and that the data is leveraged using the related command to transfer data from the dimension tables into the primary tables. If only one successful table join is observed the skill is rated a 0.5. Two or more successful table joins increases the score to a 1.0. Since students use their own data sets to create a successful join, they often transform their data using filters, or concatenations, to summarize and adapt their data to achieve a many-to-one relationship. The necessary transformation skills are acquired throughout the term while completing ICAs.

Capability 2 is evaluated by Power View/Power BI desktop dashboards generated by the students. The Power View/Power BI desktop dashboard provides students with the ability to create an interactive, visually attractive representation of their data to convey a story. For instance, users can select then drill down on a geographic region (state) while the audience sees the simultaneous impact of the selection on the other four or five visualizations in the dashboard. When related images are incorporated with data driven visualizations such as heat maps, graphs, and pie charts, the dashboard comes to life as an interactive infographic well suited for story telling with data. Including a base Power View/Power BI desktop dashboard adds 0.5 to the student level SKILLS score. Power View/Power BI desktop provides functionality to improve the visual appeal of the dashboard beyond the standard output. In addition to the base score, we add 0.25 for improvements to the dashboard appearance such as highlighted titles varied fonts, background changes, text boxes and the addition of topic related images. Finally, the instructions require that all student dashboard submissions include four or more interactive visualizations (charts, tables) and we increment their Capability 2 score by .25 for meeting or exceeding this deliverable.

Capability 3 requires a three-step review of the presentation and final Data Challenge report for analysis and interpretation of their PLS SEM regression results. The preparation and successful loading of their data into a Smart PLS model is extensive, so any model output included in their report adds 0.5 to their composite SKILLS score. Second, we evaluate the plausibility of the conceptual model to ensure that their associations are neither axiomatic or spurious, such as gender predicting pregnancies or NFL quarterback passer ratings predicting crime. If their model leverages their data to answer pre-determined research questions in a reasonable manner, then 0.25 was added to their composite SKILLS score. Third, each model requires students to run at least 1000 bootstrap samples to generate student T estimates and their corresponding p values based on the sample size in their data set. If the results are significant, we add an additional 0.25 to their SKILLS score.

4.2 Independent Variables and Controls

Our independent variables consist of the student engagement technologies and pedagogical approaches used in the class over six semesters. We operationalize the student engagement techniques group formation (GRP) and reflective discussion (DISC) as binary variables (0 or 1) based on the introduction or phase out of the technique as shown in Table 1. We capture the number of ICAs each student successfully completed over the term (ICA). Over time, the number of ICAs rose from fourteen to twenty, with additional assignments focusing on reinforcing SKILLS. In the during-COVID period, ICAs that did not positively impact SKILLS are dropped when the academic calendar was shortened by two weeks for Fall 2020 and Spring 2021. The FLIPPED variable indicates instruction using a flipped classroom pedagogical approach with lectures pre-recorded using Kaltura videos accompanied by practice files and problems to support the videos. The flipped classroom variable is operationalized in binary form (0 or 1). Finally, as a control variable, we include the number of homework assignments each student is expected to complete (HMWK). Table 1 provides additional details about each measure and informing sources.

4.3 Analysis

For analysis, we use a PLS-SEM regression software tool named Smart PLS 2.0 (Ringle et al., 2005). PLS-SEM is a second-generation statistical technique that is becoming widely used in exploratory research, as it is appropriate when sample sizes are small ($n < 200$) (Kline, 2015) or very large, and models incorporate newer key target constructs such as SKILLS (Hair et al., 2019). Smart PLS incorporates bootstrapping in calculating its standard error estimates for significance determination, which supports fewer distributional assumptions than other similar software (Gefen et al., 2011). In addition to reflective survey measures, which are usually crafted to confirm a well-developed theory, PLS-SEM permits the unrestricted use of single-item (Group, ICA, Discussion, Flipped, Homework) and formative (SKILLS) measures (Hair et al., 2014). PLS-SEM allows the researcher to analyze models using many different data configurations (reflective, formative, secondary) which is particularly beneficial in big data applications (Rigdon et al., 2017). Students in the focal BI class use the data collected in this study to learn Smart PLS, reinforcing the pedagogical approaches we have chosen, and students then use the same well suited tool (Rigdon et al., 2017) for their data challenge projects - often with very large data sets.

5. RESULTS

We use a Smart PLS 2.0 SEM analysis with 1,000 bootstrap samples to test our research model. PLS-SEM does not assume that the data are normally distributed, and applies nonparametric bootstrapping (Hair et al., 2011). Bootstrapping is a technique that involves repeated random sampling with replacement from the original sample to determine standard errors for significance testing (Hair et al., 2011; Streukens & Leroi-Werelds, 2016). We follow the PLS-SEM reporting and analysis guidelines prescribed by Gefen et al. (2011) and Hair et al. (2019).

We report standardized path coefficients, standard error (in parentheses), and significance of each path in Figure 3 and in Table 3. It is not necessary to control for instructor because the same professor taught all six sections of the course included in the analysis. We include individual student completion of homework assignments (HMWK) as a control, but do not find a significant effect on SKILLS as HMWK > SKILLS = .125 (.090) NS.

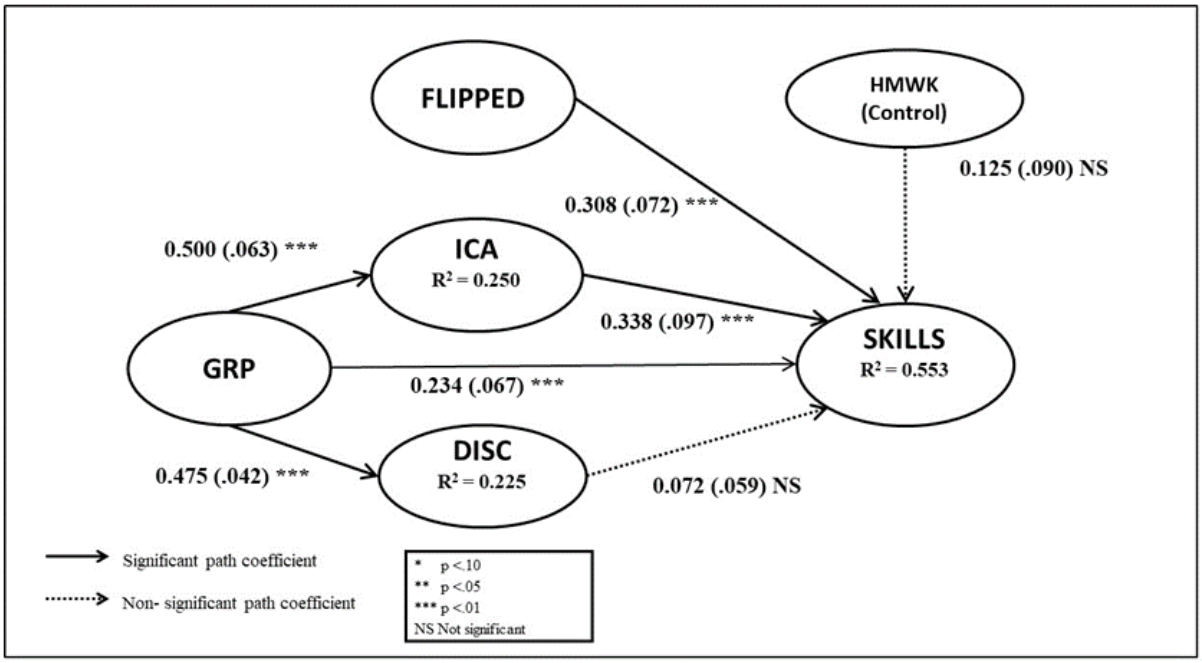

Figure 3. Structural Model Estimation Results

Main Effects			T Value	Results	Research Question	Hypothesis Confirmed
β1: GRP	→	ICA	7.868	.500 (.063) ***	RQ1	Yes
β2: GRP	→	DISC	10.651	.475 (.042) ***	RQ1	Yes
β3: GRP	→	SKILLS	2.792	.234 (.067) ***	RQ1	Yes
β4: FLIPPED	→	SKILLS	4.228	.308 (.072) ***	RQ2	Yes
β5: ICA	→	SKILLS	3.406	.338 (.097) ***	RQ1	Yes
β6: DISC	→	SKILLS	1.155	.072 (.059) NS	RQ1	No
DISC R^2				.225		
ICA R^2				.250		
SKILLS R^2				.553		
Controls			T Value	Results		
HMWK	→	SKILLS	1.355	.125 (.090) NS		

1.Standardized coefficients are reported; standard errors in parentheses.
2.***p < .01, **p < .05, *p < .10, NS: Not significant.

Table 3. Structural Model Estimation Results

5.1 Effective Student Engagement Techniques

RQ1 asks "What student engagement techniques are effective for BI skills attainment?" Based on the SEM results shown in Table 3, group formation and in-class assignments are both effective while discussion is not. Testing for the effect of DISC on SKILLS (β6 = .172, p > .10 NS) indicates that discussion does not yield a significant effect on SKILLS. Further elaboration on our observations is included on the following subsections.

5.1.1 Group Formation. Group formation as a means to provide students with a support mechanism throughout the semester is a positive and important factor across modalities of instruction supporting BI skills attainment. Our results find that GRP has a strong positive and significant association with the number of ICAs successfully completed by each student during the semester (ICA) (β1 = .500, p < .01). All reported path coefficients are standardized so, when controlling for other constructs in the model, for every one unit increase in GRP, we find a corresponding .50 increase in ICA. By forming groups at the beginning of the semester and requiring students to problem solve together, the instructor is able to introduce additional ICAs designed to reinforce SKILLS attainment. It is important to highlight that, during COVID, the number of available ICAs is reduced from 20 to 17. The decline is not due to the modality of instruction but instead due to a reduction in the school term by two full weeks.

Our results also find that GRP provides problem solving support on (ICA) but also has a strong and significant direct effect on SKILLS (β3 = .234, p < .01). These empirical results clearly indicate that semester long group formation (GRP) has a positive and significant association with SKILLS that holds across pre-COVID and during-COVID modalities.

5.1.2 In Class Assignments. Our results also find that increased levels of ICA are positively associated with SKILLS (β5 = .338, p < .01). ICAs relied on scaffolding from earlier assignments completed as homework or during class. Lectures introduce new BI functionality, either in class face-to-face or through Kaltura videos. Thus, each in-class assignment is a composite of new skills and a reinforcement of previously covered skills. For RQ1, we find strong support for the proposition that the in-class assignment component of active learning has a positive impact on BI skills attainment across modalities. In fact, we also discovered that cooperative and/or collaborative completion of in-class assignments (ICA) is the strongest predictor of SKILLS in our model.

5.1.3 Interaction Effects. We also find that GRP is positively and significantly associated with DISC (β2 = .475, p < .01). By allowing students to discuss topics first within their small groups, more students participate in class-wide conversations in which it is common for only a few dominant students to voice their opinions. For disclosure purposes we do not empirically capture the quantity and quality of student-led discussions but instead measure this construct using the semester in which discussion-based activities are systematically introduced.

Next, we test the mediated effects of GRP on SKILLS through ICA and discussion (DISC). Our results indicate that the impact of GRP on SKILLS is partially mediated through ICA. To confirm the mediated effects of GRP on SKILLS through ICA, we incorporate a product-of-coefficients test, as prescribed by Preacher et al. (2007), which utilizes our 1000 bootstrap samples to estimate the standard error. Unlike earlier mediation tests such as the Sobel test (Baron & Kenny, 1986), the product-of-coefficients approach does not require distributional assumptions (Preacher et al., 2007). We find that the mediated effect is positive and significant (σ = .049, z' = .166, p < .01), thus suggesting that the impact of GRP on SKILLS is partially mediated through ICA. Given that the effect of discussion (DISC) on SKILLS is non-significant, we forego the product-of-coefficients test of GRP on SKILLS through DISC.

5.1.4 Impact of Flipped Learning During the Pandemic. Finally, to answer RQ2, "How did adopting a flipped learning approach during the pandemic affect BI skills achievement?" we empirically test the impact of FLIPPED on SKILLS. Results indicate that providing Kaltura videos of all lecture material ahead of a synchronous remote Blackboard Collaborate session is positively and significantly associated with SKILLS (β4 = .308, p < .01). We find strong support that flipped learning has a positive impact. Compared to earlier face-to-face sessions pre-COVID, the flipped classroom approach during-COVID

results in higher SKILLS as demonstrated anecdotally by the student presentations and empirically using final Data Challenge reports.

As a robustness test, we also perform a difference of means test to evaluate the effect of FLIPPED during-COVID on student BI skills achievement. Since we have unequal samples, we use the Welch's T test (Welch, 1947), which uses the mean, standard deviation, and sample size of the total SKILLS score for each student prior to COVID ($\bar{x}$ = 1.654, σ = 0.964, n = 99) and compares these to the equivalent total SKILLS statistics after COVID ($\bar{x}$ = 2.619, σ = 0.686, n = 63). We find that t = -7.386, p < .001, confirming that the flipped learning pedagogical approach is significantly and positively associated with higher SKILLS attainment.

6. DISCUSSION

In summary, the COVID-19 pandemic ERT for the BI course includes a transition from a face-to-face classroom learning environment with in-class lectures to an online flipped classroom pedagogical approach that maintains ICA's, groups, and discussion as active learning student engagement techniques. This ERT has created a unique opportunity to rethink the course design and innovate using instructional strategies that are well-suited to online learning. In this section, we share four lessons learned from our study and provide insights other instructors may find helpful.

6.1 Lesson 1: Rethinking Groupwork

Incorporating in-class assignments using a group-based approach is highly effective in both traditional face-to-face and online modalities. Consistent with the literature, we find that collaborative and cooperative in class activities improve student learning outcomes (Johnson & Johnson, 1989; Romanow et al., 2020); however, we use different approaches in each delivery mode.

In the traditional face-to-face version of this course, the instructor introduces new skills and concepts through lecture before releasing the in-class assignment for students to work on for the remainder of the class. The delay in assignment availability encourages students to listen carefully to the lecture and note common problems and pitfalls before starting the assignment. To encourage peer-to-peer interaction, students with questions are required to first consult their group members. The instructor engages with the group to facilitate problem solving only after all group members' ideas are exhausted.

In the online version of this course, instructional videos and PowerPoint slides are released a week in advance and ICAs are released the day before class. This pre-class preparation is an important tenant of flipped learning, which allows students to fully participate during class time (Rasheed et al., 2020). This effectively seeds the class with a sprinkling of very well-prepared students who are able to serve as mentors to their peers. During class, students still meet in groups to complete the in-class assignments, using primarily other group members for assistance, but involving the instructor if needed. After the designated group time, students return to the full class session for wrap-up discussion.

Interestingly, the instructor anecdotally observed that both delivery methods are effective and support BI skills attainment, but in different ways. Students in traditional instructional settings benefit from quicker response time to questions with fewer constraints, as well as easier access to troubleshooting assistance on assignments either from the instructor or other group members. Students in a flipped online class have more access to supporting lecture materials, along with captioning that can be reviewed well before the synchronous online session.

6.2 Lesson 2: Combatting Disengagement

In an online flipped environment, some students struggle to remain engaged inside the virtual classroom. In a flipped online environment, it is critical for students to be engaged, independent learners (Dick, 2021). Yet, it is challenging to always capture students' attention during virtual class meetings. In some cases, students engaged in multitasking during virtual classes in a way that might not have been possible in a traditional in-person course. For example, students are able to simultaneously log into a class session while they are doing other cognitively or physically demanding activities (driving, working, exercising, attending to children, etc.). Some students may simply log into the class then walk away from the screen. To encourage active engagement, the instructor needs to set clear expectations as to what constitutes attendance. This might include requiring students to keep their cameras on, emphasizing that class sessions may not be recorded, and/or incorporating frequent low-stakes interactive polls.

Occasionally, technical factors thwart engagement. During the ERT, some students had intermittent problems with off-campus Internet access. After receiving several complaints, the institution designated locations where students could park their cars to access free college Wi-Fi. Also, student-owned personal laptops may not meet the minimum system requirements needed to install BI software tools and process large data sets. To address this issue, the institution studied drastically expanding their laptop loaner program. Anecdotal comments from students indicate that these programs are well received and widely used, particularly in MIS courses. Instructors and institutions need to ensure students can access the resources necessary to be successful.

6.3 Lesson 3: Project Based Learning

The Data Challenge is an effective summative assessment that allows students to apply skills learned in a new context and that augments their portfolio. Yazici (2020) also found that project-based learning is an effective approach for teaching business analytics. With the Data Challenge project, students are exposed to the limitations and "messiness" of real-world data. While many students are adept at following step by step instructions to build their comprehension of the BI tool functionality, for some, the application of these skills to real life messy data proves difficult. In this course, working with a partner, students select their own research questions and data sources, choosing primarily among the more than two hundred thousand government data sets at Data.gov. While students are given specific guidelines and objectives to complete the project, the permutations and combinations of data, research questions, visualizations, and data models with acceptable outcomes are infinite. The open-ended nature of a project can be initially frustrating for students, but we found it is also a way to engage many of them. The result is both a sense of accomplishment for the student and a tangible artifact for their portfolio. Several students reported discussing the data challenge project during job interviews to illustrate their technical and analytical skills.

6.4 Lesson 4: Online Class Discussion

The role of discussion in the online classroom needs to be reconsidered. Although discussion in the in-person classroom positively impacts BI skills attainment, the same impact was not seen online. Student engagement during online discussion, as observed by the instructor, appears effective. There are several specific challenges. First, the use of online collaboration tools for meetings and discussions has a learning curve. It takes time to learn to effectively use tools like virtual hand-raising to avoid interrupting, or posting in the group chat to ask questions or make comments. Second, not all students have reliable high-speed Internet access. Network lag times make discussion challenging. Third, the first collaboration tool used (Blackboard Collaborate) lacked robust support for breakout groups. For instance, it did not support creation of persistent breakout groups for an entire semester. This meant the instructor could not easily exploit priming students for discussion by first breaking them into small groups (Brookfield & Preskill, 2005). Fortunately, since Spring 2020, when the pandemic forced us into a new model of instruction, student and instructor familiarity with online lecture delivery and collaboration tools has increased significantly. Network capabilities are increasing and being hardened against new threats, and new software is improving and enhancing collaboration tools with support for full-term breakout groups. Instructors now have new and exciting opportunities for the enhanced use of discussion in future online versions of their course.

7. CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

This paper is a longitudinal study of an undergraduate BI course over six semesters. The instructor implements a variety of student engagement techniques including discussion, group formation, and in-class assignments. A unique aspect of this study is the inclusion of sample data focused on student learning pre-COVID using an active learning pedagogical approach, as well as during-COVID instruction augmented by a flipped learning pedagogical approach. Given the tremendous shock of emergency remote teaching (ERT), we were not able to predict a priori which techniques would continue to be effective. Our findings indicate that indeed there are differences. Regression results indicate a flipped approach in an online environment significantly improves skills attainment, and group formation continued to enhance in-class assignment completion and reflection. Unfortunately, discussion becomes a less impactful student engagement technique in an online environment. All six sections of the course analyzed in this study are taught by a single instructor and data from all enrolled students are included. Within the subject institution, this study has both reliability and validity.

There are opportunities for future research. For instance, it would be interesting to see whether similar and generalizable results are observed and even amplified in other disciplines, across sections taught by multiple instructors, and in courses taught in large sections (>100 students). Future research is also needed to explore the nuances of how to incorporate discussion most effectively in an online instructional environment.

Several limitations of this study illuminate the need for additional research. First, this study was conducted at an institution where students and faculty tend to be more familiar with and, particularly in the case of faculty, more biased toward in-person learning. Initially, ERT techniques represented an unfamiliar landscape; however, as the pandemic continued, more faculty across the institution were using these techniques and students became more adept at online learning. Future research could study how these results change as our institutional norms embrace online delivery. Future research could also compare our results to those at institutions that have a more established tradition of online learning.

Second, this study only considers the effectiveness of student engagement techniques by looking at BI skills attainment. Future research could consider students' perceptions of the class and levels of engagement as well.

A final limitation relates to the teaching delivery modes. Pre-COVID data includes only in-person learning. During-COVID data includes both the ERT and a simultaneous shift to flipped learning. Disaggregation of these simultaneous changes, as well as including other modalities like HyFlex (Howell, 2022; Kohnke & Moorhouse, 2021), all represent opportunities for future research. Future research is needed to better understand the implications for student learning and to provide robust comparative analyses of the variety of delivery methods now being offered to students. Although the ERT is largely now behind us, the technology-enabled flexibility and other perceived benefits of process and procedures introduced during the pandemic will persist well into the future and require further study.

8. REFERENCES

Anand, B. (2022, December 11). Power BI Developer Future Scope [2023 Insights]. *Knowledgehut*. https://www.knowledgehut.com/blog/business-intelligence-and-visualization/power-bi-developer-future

Anderson, P., Bowring, J., McCauley, R., Pothering, G., & Starr, C. (2014). An Undergraduate Degree in Data Science: Curriculum and a Decade of Implementation Experience. *Proceedings of the 45th ACM Technical Symposium on Computer Science Education*. https://doi.org/10.1145/2538862.2538936

Baron, R. M., & Kenny, D. A. (1986). The Moderator–Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology,* 51(6), 1173-1182. https://doi.org/10.1037/0022-3514.51.6.1173

Brookfield, S. D., & Preskill, S. (2005). *Discussion as a Way of Teaching: Tools and Techniques for Democratic Classrooms* (2nd ed.). Jossey-Bass.

Chiang, R. H., Goes, P., & Stohr, E. A. (2012). Business Intelligence and Analytics Education, and Program Development: A Unique Opportunity for the Information Systems Discipline. *ACM Transactions on Management Information Systems* 3(3), 1-12. https://doi.org/10.1145/2361256.2361257

Conduit, J., Plewa, C., Ho, J., & Lu, V. N. (2017). Facilitating Student Interaction Capabilities: The Interplay of Individual, Group, and Course-Related Factors. *Journal of Strategic Marketing,* 25(2), 114-127. https://doi.org/10.1080/0965254X.2016.1182575

Dadach, Z. E. (2013). Quantifying the Effects of an Active Learning Strategy on the Motivation of Students. *International Journal of Engineering Education,* 29(4),

904-913. https://www.researchgate.net/profile/Zin-Eddine-Dadach/post/Is-changing-teaching-practice-in-relation-to-what-students-want-from-their-learning-experience-really-a-good-idea/attachment/59d65a0b79197b80779af49b/AS%3A544957150183424%401506939317203/download/activelearningstrategy.pdf

Dick, G. (2021). Teaching Online: Creating Student Engagement. *Communications of the Association for Information Systems,* 48(1), 65-72. https://doi.org/10.17705/1CAIS.04809

Dudley-Marling, C. (2013). Discussion in Postsecondary Classrooms: A Review of the Literature. *SAGE Open,* 3(4), 1-13. https://doi.org/10.1177/2158244013515688

Eeds, M., & Wells, D. (1991). Talking, Thinking, and Cooperative Learning: Lessons Learned from Listening to Children Talk About Books. *Social Education,* 55(2), 134-137. https://eric.ed.gov/?id=EJ427733

Ezeh, C., Adesope, O., Kehinde, O., & Jaiyeola, E. (2023). Efiects of Flipped Instruction on College Students' Learning in STEM Subject Domains: A Meta-Analysis. *Journal of STEM Education,* 23(4), 33-48. https://www.jstem.org/jstem/index.php/JSTEM/article/view/2521

Fenlon, M., & Fitzgerald, B. K. (2017). *Investing in America's Data Science and Analytics Talent-The Case for Action*. https://bigdata.ieee.org/images/files/pdf/Investing-in-Americas-DSA-Talent_BHEF-and-PwC.pdf

Fottrell, Q. (2019). The 'Best Job in America' Pays Over $108,000 a Year — And Has a High Number of Openings. *Marketwatch*. https://www.marketwatch.com/story/the-no-1-job-in-america-pays-108000-a-year-2019-05-03?mod=MW_home_top_stories

Gartner. (2017, January 16). *Gartner Says More Than 40 Percent of Data Science Tasks Will Be Automated by 2020*. https://www.gartner.com/en/newsroom/press-releases/2017-01-16-gartner-says-more-than-40-percent-of-data-science-tasks-will-be-automated-by-2020

Gefen, D., Rigdon, E. E., & Straub, D. (2011). Editor's Comments: An Update and Extension to SEM Guidelines for Administrative and Social Science Research. *MIS Quarterly*, 35(2), iii-xiv. https://doi.org/10.2307/23044042

Goh, S. H., Di Gangi, P. M., & Gunnells, K. (2020). Applying Team-Based Learning in Online Introductory Information Systems Courses. *Journal of Information Systems Education,* 31(1), 1-11. http://jise.org/Volume31/n1/JISEv31n1p1.pdf

Gupta, B., Goul, M., & Dinter, B. (2015). Business Intelligence and Big Data in Higher Education: Status of a Multi-Year Model Curriculum Development Effort for Business School Undergraduates, MS Graduates, and MBAs. *Communications of the Association for Information Systems* 36, 449-476. https://doi.org/10.17705/1CAIS.03623

Hair, J., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to Use and How to Report the Results of PLS-SEM. *European Business Review,* 31(1), 2-24. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J., Sarstedt, M., Hopkins, L., & G. Kuppelwieser, V. (2014). Partial Least Squares Structural Equation Modeling (PLS-SEM): An Emerging Tool in Business Research. *European Business Review,* 26(2), 106-121. https://doi.org/10.1108/EBR-10-2013-0128

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice,* 19(2), 139-152. https://doi.org/10.2753/MTP1069-6679190202

Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., & Bond, M. A. (2020). The Difference Between Emergency Remote Teaching and Online Learning. *Educause Review*. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning.

Howell, E. (2022). HyFlex Model of Higher Education: Understanding the Promise of Flexibility. *On the Horizon: The International Journal of Learning Futures,* 30(4), 173-181. https://doi.org/10.1108/OTH-04-2022-0019

Jeyaraj, A. (2019). Pedagogy for Business Analytics Courses. *Journal of Information Systems Education,* 30(2), 67-83. http://jise.org/Volume30/n2/JISEv30n2p67.pdf

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and Competition: Theory and Research*. Interaction Book Company.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1998). Cooperative Learning Returns to College: What Evidence is There That It Works? *Change:The Magazine of Higher Learning,* 30(4), 26-35. https://doi.org/10.1080/00091389809602629

Kang, J. W., Holden, E. P., & Yu, Q. (2015). Pillars of Analytics Applied in MS Degree in Information Sciences and Technologies. *Proceedings of the 16th Annual Conference on Information Technology Education*. https://doi.org/10.1145/2808006.2808028

Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling* (3rd ed.). Guilford Publications.

Kohnke, L., & Moorhouse, B. L. (2021). Adopting HyFlex in Higher Education in Response to COVID-19: Students' Perspectives. *Open Learning: The Journal of Open, Distance and e-Learning,* 36(3), 231-244. https://doi.org/10.1080/02680513.2021.1906641

Lewis, L. H., & Williams, C. J. (1994). Experiential Learning: Past and Present. *New Directions for Adult and Continuing Education,* 1994(62), 5-16. https://doi.org/10.1002/ace.36719946203

Ling, L., & Ling, P. (2020). Guest Editorial. *Qualitative Research Journal,* 20(4), 343-349. https://doi.org/10.1108/QRJ-11-2020-107

Mercer, N., & Howe, C. (2012). Explaining the Dialogic Processes of Teaching and Learning: The Value and Potential of Sociocultural Theory. *Learning, Culture and Social Interaction,* 1(1), 12-21. https://doi.org/10.1016/j.lcsi.2012.03.001

Mills, R. J., Chudoba, K. M., & Olsen, D. H. (2016). IS Programs Responding to Industry Demands for Data Scientists: A Comparison between 2011-2016. *Journal of Information Systems Education,* 27(2), 131-140. http://jise.org/Volume27/n2/JISEv27n2p131.pdf

Mok, H. N. (2014). Teaching Tip: The Flipped Classroom. *Journal of Information Systems Education,* 25(1), 7-11. http://jise.org/Volume25/n1/JISEv25n1p7.html

Napier, N. (2018). Super Saturday Series (S3) Dashboard in Power View. *Information Systems Education Journal,* 16(2), 4-10. https://isedj.org/2018-16/n2/ISEDJv16n2p4.pdf

Napier, N., & Johnson, R. (2007). Technical Projects: Understanding Teamwork Satisfaction In an Introductory IS Course. *Journal of Information Systems Education,* 18(1), 39-48. http://jise.org/Volume18/n1/JISEv18n1p39.pdf

Olitsky, N. H., & Cosgrove, S. B. (2016). The Better Blend? Flipping the Principles of Microeconomics Classroom. *International Review of Economics Education,* 21, 1-11. https://doi.org/10.1016/j.iree.2015.10.004

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing Moderated Mediation Hypotheses: Theory, Methods, and Prescriptions. *Multivariate Behavioral Research,* 42(1), 185-227. https://doi.org/10.1080/00273170701341316

Prince, M. (2004). Does Active Learning Work? A Review of the Research. *Journal of Engineering Education,* 93(3), 223-231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Rasheed, R. A., Kamsin, A., Abdullah, N. A., Kakudi, H. A., Ali, A. S., Musa, A. S., & Yahaya, A. S. (2020). Self-Regulated Learning in Flipped Classrooms: A Systematic Literature Review. *International Journal of Information and Education Technology,* 10(11), 848-853. https://doi.org/10.18178/ijiet.2020.10.11.1469

Rigdon, E. E., Sarstedt, M., & Ringle, C. M. (2017). On Comparing Results From CB-SEM and PLS-SEM: Five Perspectives and Five Recommendations. *Marketing: ZFP–Journal of Research and Management,* 39(3), 4-16. https://doi.org/10.15358/0344-1369-2017-3-4

Ringle, C. M., Wende, S., & Will, S. (2005). *SmartPLS 2.0 (M3) Beta, Hamburg 2005.*

Riordan, R. J., Hine, M. J., & Smith, T. C. (2017). An Integrated Learning Approach to Teaching an Undergraduate Information Systems Course. *Journal of Information Systems Education,* 28(1), 59-70. https://aisel.aisnet.org/jise/vol28/iss1/5

Romanow, D., Napier, N. P., & Cline, M. K. (2020). Using Active Learning, Group Formation, and Discussion to Increase Student Learning: A Business Intelligence Skills Analysis. *Journal of Information Systems Education,* 31(3), 218-231. https://aisel.aisnet.org/jise/vol31/iss3/6

Singh, P., Harangee, J., & Prinsloo, T. (2022). Reflections and Experiences in a Fundamental Digital Literacy Course: A Study During the Covid-19 Pandemic. *Communications of the Association for Information Systems,* 51(35), 886-880. https://doi.org/10.17705/1CAIS.05135

Stefanou, C., Lord, S. M., Prince, M. J., & Stolk, J. (2012). The Effect of Different Active Learning Environments on Student Outcomes Related to Lifelong Learning. *International Journal of Engineering Education, 28*(3), 606-620. https://www.researchgate.net/publication/257823637_The_Effect_of_Different_Active_Learning_Environments_on_Student_Outcomes_Related_to_Lifelong_Learning

Strayer, J. F., Gerstenschlager, N. E., Green, L. B., McCormick, N., McDaniel, S., & Rowell, G. H. (2019). Toward a Full(er) Implementation of Active Learning. *Statistics Education Research Journal,* 18(1), 63-82. https://doi.org/10.52041/serj.v18i1.150

Strelan, P., Osborn, A., & Palmer, E. (2020). The Flipped Classroom: A Meta-Analysis of Effects on Student Performance Across Disciplines and Education Levels. *Educational Research Review,* 30, 1-22. https://doi.org/10.1016/j.edurev.2020.100314

Streukens, S., & Leroi-Werelds, S. (2016). Bootstrapping and PLS-SEM: A Step-by-Step Guide to Get More out of Your Bootstrap Results. *European Management Journal,* 34(6), 618-632. https://doi.org/10.1016/j.emj.2016.06.003

Swart, W. W., & MacLeod, K. R. (2020). Flipping Online Analytics Classes: Achieving Parity With Their Face-to-Face Counterparts. *Decision Sciences Journal of Innovative Education,* 18(1), 119-137. https://doi.org/10.1111/dsji.12200

Topi, H. (2019). Reflections on the Current State and Future of Information Systems Education. *Journal of Information Systems Education,* 30(1), 1-9. http://jise.org/Volume30/n1/JISEv30n1p1.pdf

Van Alten, D., Phielix, C., Janssen, J., & Kester, L. (2019). Effects of Flipping the Classroom on Learning Outcomes and Satisfaction: A Meta-Analysis. *Educational Research Review,* 28, 100281. https://doi.org/https://doi.org/10.1016/j.edurev.2019.05.003

Welch, B. L. (1947). The Generalization of 'Student's' Problem When Several Different Population Varlances Are Involved. *Biometrika,* 34(1-2), 28-35. https://doi.org/10.1093/biomet/34.1-2.28

Williams, B., & Elmore, R. (2021). Teaching Business Analytics During the COVID-19 Pandemic: A Tale of Two Courses. *Communications of the Association for Information Systems,* 48(1), 32-39. https://doi.org/10.17705/1CAIS.04805

Wixom, B., Ariyachandra, T., Goul, M., Gray, P., Kulkarni, U., & Phillips-Wren, G. (2014). The Current State of Business Intelligence in Academia. *Communications of the Association for Information Systems,* 34(1), 1-13. https://doi.org/10.17705/1CAIS.02916

Yazici, H. J. (2020). Project-Based Learning for Teaching Business Analytics in the Undergraduate Curriculum. *Decision Sciences Journal of Innovative Education,* 18(4), 589-611. https://doi.org/10.1111/dsji.12219

AUTHOR BIOGRAPHIES

Darryl Romanow is an assistant professor of management information systems at Georgia Gwinnett College. His main research area is in the domain of Health IT, and his research interests cover adoption and diffusion of IT, implementation strategy, chronic patient care, and IT enabled coordination. His work has appeared in *MIS Quarterly*, *Journal of Information Systems Education*, *International Journal of Medical Informatics*, and *Harvard Business School Publishing*.

Melinda K. Cline is a professor of management information systems and the assistant department chair of the Finance, Accounting, and MIS department in the School of Business at Georgia Gwinnett College. Her research interests include the value of IS investments and project management. Her work has been published in numerous academic journals including *Decision Support Systems*, *Journal of Computer Information Systems*, *Information Systems Management*, *Journal of Information Systems Education*, and *Managerial Auditing*.

Nannette P. Napier is a clinical professor of computer information systems in the Robinson College of Business at Georgia State University. Her research involves understanding and solving problems that lead to failed software development projects. She actively leads initiatives focused on recruiting and retaining students traditionally underrepresented in technology careers.

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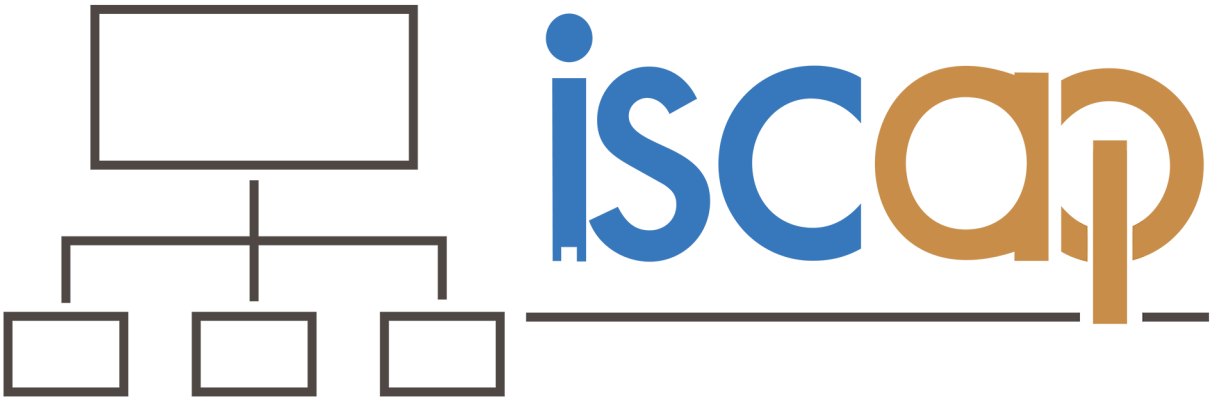

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ISSN: 2574-3872 (Online) 1055-3096 (Print)