Teaching Tip
A Social Media Analytics Capstone Research Project with Community Engagement

Chen Ye and Lin Zhao

Find archived papers, submission instructions, terms of use, and much more at the JISE website:
https://jise.org

Teaching Tip
A Social Media Analytics Capstone Research Project with Community Engagement

Chen Ye
Department of Quantitative Business Studies
Purdue University Northwest
Hammond, IN 46323, USA
chenye@pnw.edu

Lin Zhao
Department of Accounting, Economics, Finance and Information Sciences
Embry-Riddle Aeronautical University
Daytona Beach, FL 32114, USA
lin.zhao@erau.edu

ABSTRACT

Businesses assess public sentiment toward relevant topics and gain valuable insights through social media analytics (SMA). Students of business information analytics can therefore reap multiple benefits from SMA as a learning tool. We designed and implemented an SMA capstone project that integrated undergraduate research and community engagement. Students first identified research questions on their topics of interest that aligned with the interests of the client, a community organization. They collected relevant tweets through Twitter's API using R and then assessed public sentiment through text mining and analytics tools such as Linguistic Inquiry and Word Count. They also presented their findings to various stakeholders through multiple venues. Preliminary assessment suggests that the students achieved positive learning outcomes.

Keywords: Social media, Business analytics, Experiential learning & education, Student research, Capstone course, Community

1. INTRODUCTION

Numerous information systems (IS) educators have contended that capstone projects offer a beneficial opportunity for students to integrate and apply the knowledge and skills they obtained throughout their entire undergraduate curriculum (Baird & Riggins, 2012; Parrish et al., 2009; Steiger, 2009). Well-designed capstone projects help students demonstrate their business, technical, and personal skills, thus improving their employment prospects after graduation (Parrish et al., 2009).

A widely adopted practice is including experiential learning in capstone courses, which requires students to synthesize previously acquired knowledge and skills to solve real-life problems (Hauck, 2018; Patten & Keane, 2009). Experiential learning can come in many different forms – such as service learning, study abroad, internships, and undergraduate research – and can occur both in and outside of the classroom (Moore, 2010). Integrating service learning and undergraduate research in a capstone class not only helps students understand the relevance of the course for their future careers but also further connects discipline-based content with the research process and community engagement experiences (Schaffer & Peterson, 1998).

Increasing industry demand for business analytics skills has led to a growing trend of incorporating data analytics into the IS curriculum (Wymbs, 2016). Educators within and outside the IS discipline have recognized social media analytics' (SMA) pedagogical value (Ewing et al., 2018; Goh & Sun, 2015). Social media platforms such as Twitter serve as rich sources of information for understanding public sentiment on a given topic. Through SMA, organizations can gain a clear overview of stakeholders' opinions and feelings about their products, services, or topical issues, thus achieving significant business value (Fan & Gordon, 2014). A study conducted by MarketsandMarkets (2021) projects that the SMA global market will almost triple in value over five years to $9.3 billion in 2026 due to "the rising number of social media users, increased focus on the market and competitive intelligence, [and] rising need for social media measurement to enhance the customer experience." Thus, the demand for SMA skills in the job market is expected to continue to rapidly increase across different business segments worldwide.

IS capstone projects traditionally involve the implementation of a technical solution, such as a database (Steiger, 2009), software application (Parrish et al., 2009), prototype of an enterprise system (Baird & Riggins, 2012), or an ERP system (Davis & Comeau, 2004). However, a search on Google Scholar and ProQuest yielded few articles addressing the pedagogical use of SMA assignments in a capstone course. Therefore, in this paper, we discuss the implementation of a service-learning SMA research project. This team-based student research project is the primary assignment in an undergraduate capstone course in the business information analytics program at a public university in the Midwestern United States. We expect instructors at other institutions interested in implementing a similar experiential learning project in SMA to find the information presented in this paper helpful.

We follow the outline for developing a teaching tip suggested by Lending and Vician (2012). We first review the relevant literature and discuss the conceptual planning of our project. We then detail the implementation of the project and, in the subsequent section, summarize the project outcomes. Lastly, we offer suggestions to instructors interested in implementing an SMA project in a capstone course and highlight potential directions for further course development.

2. LITERATURE REVIEW

2.1 Service Learning and Undergraduate Research

Service learning is a form of experiential education that merges community engagement and high-impact learning activities across institutions and disciplines (Felten & Clayton, 2011; Hoxmeier & Lenk, 2003). The numerous definitions of service learning in the literature all mention three core characteristics: common goals shared by academia and the community; reciprocal relations among students, faculty, and the community; and the mutual benefits of learning and service (Felten & Clayton, 2011). Service learning is a well-recognized teaching approach that addresses significant community needs through a course or program and enhances students' academic performance (Astin et al., 2000), personal development (Kuh, 2008), and sense of lifelong civic engagement (Eyler & Giles, 1999). It is particularly well suited for project-based capstone classes involving quantitative reasoning and critical thinking (Patten & Keane, 2009; Gan et al., 2020).

One of the main curricular settings supported by the Association for Experiential Education and the National Society for Experiential Education is undergraduate research (UR), which requires students to work closely with faculty members to conduct high-quality and original research projects. UR helps students develop important analytical and soft skills, giving them a competitive edge for jobs and graduate school admissions. The academic and social value of UR includes promoting students' educational success (Eagan et al., 2013), career development (Lopatto, 2004), and personal and professional growth (Bauer & Bennett, 2003; Hunter et al., 2007). Although efforts to capitalize on the benefits of UR have largely targeted high-achieving students, a capstone class driven by practitioner-oriented UR projects can effectively extend the benefits to all students to create a more inclusive learning environment (Henderson, 2016).

Overall, ample research demonstrates the advantages of service learning and UR, but few studies have explored best practices for integrating both teaching strategies in a single course. Furthermore, to our knowledge, no study has addressed integrative experiences in a capstone class within the IS or business analytics field.

2.2 Public Sentiment Research and Social Media Analytics

Various studies have used social media platforms as a source of information for understanding public sentiment toward a social topic. Sentiment analysis, one of the most important techniques for mining social media websites, is "the process of quantifying the emotional value in a series of words or text, to gain an understanding of the attitudes, opinions and emotions (positive, negative and neutral) expressed" (Redhu et al., 2018). Twitter, which had 229 million daily active users during the first quarter of 2022, is one of the world's most widely used social media platforms. As of October 2022, twitter.com is the fourth-most visited website worldwide (Similarweb, 2022). Twitter users make short text-based posts called tweets. Unlike other leading platforms such as Instagram and WeChat, Twitter users primarily publicly express their opinions and feelings as text written in English (Statista.com, 2022). Therefore, researchers have found Twitter to be a valuable source of data for assessing public sentiment toward a wide range of topics (Lundgaard et al., 2018). Furthermore, Twitter can also be used to examine the sentiments of stakeholders of local public organizations during natural disasters (Subba & Bui, 2017).
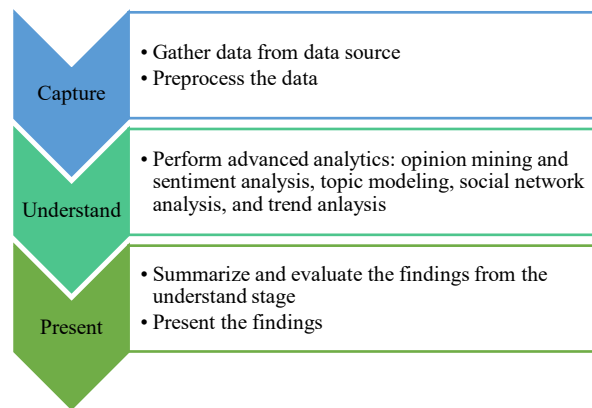
Figure 1. The Capture, Understand, Present Framework of Social Media Analytics (adapted from Fan & Gordon, 2014)

To guide the practical application of SMA, Fan and Gordon (2014) developed the capture, understand, and present (CUP) framework, illustrated in Figure 1. According to the CUP framework, the process of SMA consists of three stages. Firstly, the capture stage pertains to obtaining relevant data from social media sources and extracting pertinent information. Secondly, the understand stage mainly involves "using various advanced data analytic methods on the data and gain[ing] insight from them" (Fan & Gordon, 2014, p. 75). Finally, the present stage refers to communicating the findings from the understand stage to stakeholders. Our implementation of the capstone project builds on an emerging stream of the reported pedagogical use of SMA projects (Subramanian & Cote, 2018). However, unlike previous SMA classroom projects that only involve some of the CUP steps, we require students to follow the entire framework

and learn to use the tools and techniques needed to collect and analyze social media data. The knowledge and skills gained as a result are valuable for students pursuing careers in business areas that require information analytics skills.

2.3 Experiential Learning Theory
Both service learning and UR fall under the umbrella of experiential learning. Kolb's (1981, 1984) experiential learning theory is widely accepted as an overarching model that explains how learners internalize knowledge through experience. The basic tenet of the model suggests that learners progress through four consecutive steps in a complete experiential learning cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation (see Figure 2). Each step in the cycle entails a different learning activity, respectively: experiencing, reflecting, thinking, and acting. Within this cycle, Kolb and Kolb (2009) consider concrete experience (experiencing) and abstract conceptualization (thinking) to be two related modes of grasping experiences. Reflective observation (reflecting) and active experimentation (acting), conversely, represent two related modes of transforming experiences. Experiential learning theory emphasizes that experiential learning is a holistic process wherein each step plays a valuable role. Learners may enter the experiential learning cycle at any one of the steps, and they may go through multiple cycles in a recursive learning process.
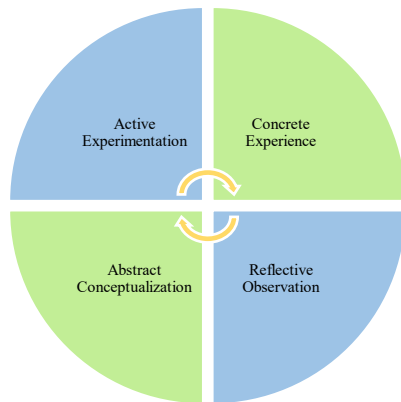

Figure 2. Kolb's Experiential Learning Model

Since its publication, Kolb's experiential learning theory has influenced the design of experiential learning courses in many academic disciplines, including IS. A literal implementation of the experiential learning model would require students to undergo the four steps in repeated cycles. However, due to the practical limitations of individual courses, instructors have incorporated activities that facilitate or promote learning objectives aligned with specific steps of the experiential learning model. An example is Corbin et al.'s (2021) study, reporting on the implementation of the experiential learning model in a project named INTEX (INTegrative EXercise) under the IS department at Brigham Young University. In INTEX, students work in groups on an intensive week-long IS case assignment and develop the required solution. The experience required students to work through the formal process of systems analysis and design and

present the final solution to industry partners serving as judges. Students accomplished reflective observation when they received constructive criticism from the judges. Activities such as self-evaluation and peer evaluation facilitated abstract conceptualization, wherein students digested the reflective observation and identified and assimilated abstract concepts as new knowledge. Lastly, students were expected to apply the knowledge and skills gained in INTEX to their current and future jobs, therefore accomplishing the step of active experimentation.

3. CONCEPTUAL PLANNING OF THE CAPTSTONE PROJECT

3.1 Course Overview
The undergraduate business information analytics (BIA) program is a recently formed program combining coursework in both IS and business analytics. When designing the current curriculum for the BIA program, the faculty agreed to include a capstone class to consolidate students' learning in one project. The capstone class is the final course in the BIA curriculum, and students are required to take it in the last semester before graduation. It is designated as an experiential learning course in the catalog and serves as the primary assessment of the BIA program. BIA faculty members teach the course on a rotating basis and bring their own interests and expertise into designing the capstone project.

As UR is considered an essential component of academic development, the university provides competitive undergraduate research grants of up to $600 per project every semester to encourage and support students' efforts and passions. UR projects are supervised by faculty members and are often incorporated into projects in capstone and senior design courses. A UR grant application is often integrated into IS and business analytics capstone courses.

3.2 Overall Design
The CUP framework provided a straightforward structure for the overall design of the course. At the beginning of the semester, students went through an additional pre-capture phase and made preparations such as team formation and deciding the research topics. Subsequently, each team applied the capture, understand, and present stages to their respective topics throughout the semester.

Similar to Corbin et al.'s (2021) project, whenever applicable, we aligned learning activities to Kolb's experiential learning cycle steps. Students conducted research projects for a community partner (see Section 4.1) using the business analytics skills and knowledge they had accumulated in previous coursework and throughout the first half of the capstone course, thus gaining c*oncrete experience*. Students achieved *reflective observation* by collecting and responding to constructive feedback from the community partner and other stakeholders. Tasks embedded in various assignments, such as explaining newly learned concepts in their own words and summarizing the project's key findings, facilitated a*bstract conceptualization*. To promote *active experimentation,* we used an online discussion to encourage students to apply the knowledge and skills gained through the project in their current and future jobs and internships.

4. IMPLEMENTATION OF THE CAPSTONE PROJECT

4.1 Preparations Before the Semester

An SMA project starts with selecting a general theme or topic (Ewing et al., 2018). Since early 2020, the COVID-19 pandemic has significantly impacted all aspects of people's lives. A clear understanding of the opinions, feelings, and concerns of stakeholders on relevant topics will undoubtedly benefit organizations facing the challenges brought about by the pandemic. Therefore, in early 2020, the course instructors decided that public sentiment during the COVID-19 pandemic would be a timely and appropriate theme for the upcoming spring 2021 semester.

Selecting a community partner is a critical and challenging step in developing effective service learning experiences. The pandemic created even more challenges in the selection process due to business disruptions and market uncertainty. As such, we targeted community partners with a history of positive cooperation with the university and the college whose core business could benefit from our project. In early 2020, we secured the Society of Innovators (SOI) as the community partner for the spring 2021 semester. Founded in 2004, the SOI is a regional non-profit organization whose primary objective is to identify, recognize, and celebrate innovation and innovators in the northwest Indiana (NWI) region. In 2018, SOI became a non-profit organization affiliated with our university with an associated IRS 501(c)(3) status. Our connection with the SOI was naturally facilitated through various channels within the university to support and augment the university's research and economic development efforts. The SOI aims to support robust regional economic development and enhance, champion, and drive a culture of innovation in the NWI region.

We convened a kick-off meeting with the leaders of the organization in May 2020. In the meeting, we presented our teaching and research background and interests and received full support from the leadership team. The SOI leaders and course instructors agreed that this would be a timely project to pursue in the spring 2021 semester and that the connection between the SOI and regional organizations would help guide the project. The community partner shared an interest in discovering patterns and trends in the sentiments of regional stakeholders during the pandemic. They believed that implementing this project would contribute to the SOI's vision of driving "economic and community development in NWI through innovation."

4.2 Project Overview and Research Question Development

The class was offered as a distance learning course in Spring 2021. Therefore, all class meetings were conducted using an online meeting tool. Appendix A provides a detailed class schedule for the semester. During the first meeting, the instructors presented an overview of SMA research projects and briefly explained the main stages of these projects, emphasizing the importance of identifying a specific research topic. Two SMA research papers published in conference proceedings (Boit & El-Gayar, 2020; Ye & Zhao, 2021) were assigned as required reading after the class.

During the second week, the SOI leadership team met with the students for the first time. They introduced the SOI and discussed the opportunities for and challenges of economic development in the NWI region during the pandemic, providing real-world examples of successes and failures experienced by regional businesses. In addition, they shared their thoughts on how to use SMA to better understand public discourse during the pandemic and thereby help regional businesses make wise decisions.

After the initial meeting with the community partner, each student was required to write a one-page reflection paper on what they had learned. Their biggest takeaways were that any business, especially a small business, must adapt to change in order to survive and excel during the pandemic, and that SMA can be a powerful real-time tool to enable informed and insightful decision-making based on public discourse.

By the end of the second week, students formed groups of four to five members and we applied group-based grading on all assignments related to the capstone project. For the rest of the semester, each group presented a weekly verbal progress report to at least one instructor and asked questions related to the project.

During the third week, students engaged in online discussions within their groups to explore and identify research topics of interest. On the discussion board, students had to start a thread before they could read and reply to other threads; therefore, each discussion began with a variety of interesting ideas. Each student had to review other posts and post at least two responses to allow each group to reach a consensus on the research questions and hypotheses through asynchronous peer interactions.

By the end of the third week, each group was required to submit an initial topic of interest related to public sentiment toward a relevant issue during the pandemic. For example, one of the groups proposed a study of public sentiment toward online shopping in the NWI region. The community partner and instructors reviewed the proposed topics and provided feedback and suggestions, leading some groups to revise their topics. After each group had finalized the topic of their project, they were required to write a two-page proposal. The deadline for the proposal coincided with the university's annual competition for undergraduate student research grants. Since we adopted the university research office's guidelines for undergraduate student research grant proposals, each group could submit their proposal to the competition with minimal additional work.

The final topics of the student groups address public sentiment in the NWI region toward issues of strong public interest, including online shopping, working from home, and in-restaurant dining. Take dining as an example: as consumers cut back on dining in restaurants in reaction to COVID-19 (Maze, 2020; Yang et al., 2020), sit-down restaurants were among the businesses most severely impacted by the pandemic (Restaurant Business, 2020; Sharma et al., 2020). Thus, insights on consumer sentiments toward in-restaurant dining during a public health crisis would be beneficial to the restaurant industry.

4.3 Data Collection (Capture)

Twitter provides an application programming interface (API) for developers and researchers to search and collect tweets posted on the platform. Those interested in data retrieval through the API must apply for access by providing their basic identity and affiliation information and stating their project's purpose. Once the application is approved, Twitter grants a set of unique keys for accessing the API. In Spring 2021, the 1.1 version of the API included a free standard tier and paid

premium tiers. Among other differences, the standard tier provided access to tweets from the past seven days, while premium tiers allowed access to the full archive. The latest information about the API can be found on the website for Twitter developer documentation (https://developer.twitter.com/en/docs/twitter-api). The API can be accessed in multiple programming languages using their respective packages. For our class, we chose to use R due to the instructors' familiarity with the language and because R is supported by the college's IT group.

During the fifth week, we gave a tutorial on data collection. During the class, we walked through the process of installing R Studio and the R packages necessary for collecting tweets through Twitter's API. We also performed a live demonstration of a sample program collecting tweets mentioning the Chicago Bears that were made within 50 miles of a specific longitude and latitude. The sample program also contains a section that performs basic data preprocessing, such as the removal of special characters that are not useful in the subsequent data analyses. Bots on Twitter often repeatedly tweet the same message, and it is possible to remove the repeated messages programmatically during data retrieval. To demonstrate this issue of data quality, the sample program left the repeated messages intact. After inspecting the tweets in the initial dataset with the students, we explained the procedure to remove tweets with identical text using the remove duplicate feature in Excel. We recorded the tutorial and posted it on the course website for students to review. We also posted instructions for the software installation and sample program for data retrieval, in addition to step-by-step instructions for applying for Twitter API access. We tasked each group to have at least one member apply for access and use their own API keys for the data retrieval.

By the end of week seven, each group had completed initial data collection by running their own program with keywords related to their research topic. We encouraged students to modify and improve upon the sample program to include additional features (e.g., additional data preprocessing). At a minimum, students could use the sample program for data retrieval with a few minor changes, including replacing the API keys, the search keywords, and the paths to save the collected tweets. One group later received a student research grant to fund premium access to the API, and we provided a different sample as the template for retrieving data through a premium tier.

4.4 Data Visualization and Data Analysis (Understand)

In weeks eight and nine, we performed a series of tutorials that guided the students through several commonly performed data analyses on a tweet data corpus. We first demonstrated how to use different tools to create a word cloud, including the Pro Word Cloud add-in in Office, as well as Tableau and some free online tools. We encouraged students to try different tools to create a word cloud from the corpus. Figure 3 illustrates a sample word cloud created by a group that studied public sentiment toward dining in restaurants. The words "open," "check," and "guide" were the most frequently used in the tweets, indicating that customers were deeply interested in discussing these salient terms, and it would be worthwhile to explore them in greater depth.

Figure 3. Sample Word Cloud from a Student Group

In week eight, we gave a lecture on sentiment analysis, an advanced analytics technique for mining social media data (Fan & Gordon, 2014; Redhu et al., 2018). Previous studies have found that user sentiments and emotions extracted from tweets can be quantified and analyzed to indicate psychological states and predict behaviors (Salehan & Kim, 2016; Wang et al., 2016). We introduced a widely used language analysis tool, Linguistic Inquiry and Word Count (LIWC), to the classroom and installed it on the lab computers and students' personal computers. By reviewing the work of Tausczik and Pennebaker (2010), students gained a fundamental understanding of LIWC, including its theoretical background, development process, and validity and power in emotion word detection. We subsequently asked the students to process tweets in LIWC 2015 and calculate the percentage of positive emotion words (e.g., like, happy) and negative emotion words (e.g., cry, terrible) in each tweet. Students also learned to measure the sentiment polarity of tweets by calculating the difference between the percentages of both emotions (no difference represented neutral emotion). Once students calculate the sentiment polarity of individual tweets, they can determine the breakdown of positive, neutral, and negative emotions in the entire corpus. As Figure 4 shows, in early Spring 2021, among the tweets mentioning dining in restaurants in NWI, 48% were neutral, 42% were positive, and 10% expressed negative emotion. The results suggested a generally positive public sentiment toward dining in restaurants during the data collection period. In real-life applications of SMA, continuous monitoring of social media conversations can help restaurant owners gain valuable real-time insights into public sentiment and thereby make more appropriate decisions about opening restaurants and ensuring safe dining.

In the last lecture on data analysis, we demonstrated an advanced SMA technique, latent Dirichlet allocation (LDA), which can mine the corpus for latent topics of public discourse (Fan & Gordon, 2014). "Topic models are algorithms for discovering the main themes that pervade a large and otherwise unstructured collection of documents," and LDA is an algorithm for probabilistic topic modeling (Blei, 2012; see the article for an explanation of the principles of LDA and an illustrative example of its application).

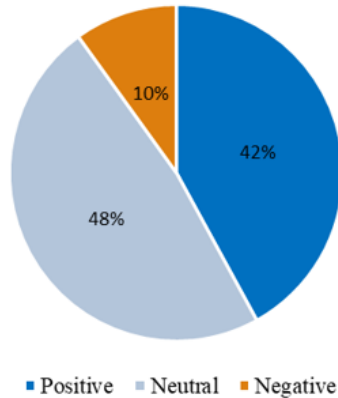Public Sentiment toward Restaurant Dining

Figure 4. Breakdown of Emotions from a Student Group

Students learned to apply LDA analysis to the preprocessed dataset using the Topic Modeling Tool for LDA, a freely available tool with an easy-to-use graphical user interface (https://code.google.com/archive/p/topic-modeling-tool/downloads). Topic modeling requires programmers to input a list of stop words (i.e., common words to be ignored in the analysis), and we used the list supplied by the Machine Learning for Language Toolkit (MALLET; available at mallet.cs.umass.edu). Following the procedure established in prior research (Bian et al., 2016), students identified distinct latent topics through an iterative process of adjusting the parameters of the LDA algorithm combined with human judgments. For example, the student group that chose online shopping as their topic discovered latent topics such as experience, food, money, and order in their corpus.

4.5 Presentations and Project Report (Present)
Each group virtually presented their preliminary results at Days of Discovery, an annual event hosted by the university for faculty and students to present their research. The event provided students with valuable experience on how to effectively structure and present material to an audience. At the end of the semester, each group also made a final presentation to the community partner. Each group received effective feedback from the SOI on how to improve their project. One week after presenting to the community partner and receiving feedback, each group submitted their final report as the last deliverable of the capstone project.

4.6 Assessment of Student Performance
Unlike some SMA learning assignments, we did not provide students with a predetermined data corpus; therefore, we did not have any sample solutions against which to compare and evaluate students' work. Instead, we used multiple tools to assess and evaluate student performance in the SMA capstone project. We determined student grades through a combination of reviews of interim project assignments, the final report, and the community partner's evaluation of the final presentation and project report. An additional component of the student's

grade was their peers' evaluations of their contributions to the team and performance during the semester.

5. EVIDENCE

In Spring 2021, 14 students enrolled in the class and successfully completed the capstone project in three groups. All students majored in BIA, with four students double majoring in finance and one double major each in accounting and human resources. The student groups examined public sentiment in the NWI region toward online shopping, working from home, and in-restaurant dining. Each group completed the required data collection and analyses and reported their results to the community partner orally and through a written report. The SOI was overall impressed by the project outcomes produced by each group and expressed a keen interest in building long-term collaboration in the future. The SOI also considered the one-page executive summary from each group helpful for future engagement with local organizations. The students disseminated their findings to the campus community through the Days of Discovery event. One of the groups also virtually presented their work at an international academic conference in summer 2021 (Steingass et al., 2021).

At the end of the semester, students reflected on what they had learned in the class and its impact on their future careers through an online discussion. Appendix B lists select reflective comments from the students. Most students recognized the overall value of the knowledge and experience gained through the capstone project. The students also demonstrated a strong interest in applying what they had learned in future jobs and internships.

We also asked students to identify any issues they experienced during the capstone project and suggest improvements for the future. More than one group reported that limiting the data collection to tweets from a specific region was overly restrictive. While this limitation was a necessary requirement due to the community partner's focus on regional developments, removing the restriction would certainly yield a much larger data corpus for any given topic. Some students suggested expanding the introduction of the research fundamentals at the start of the semester. The students highlighted the need for a specific introduction to text analytics, as some students had no exposure to analyzing textual data in prior coursework. Additionally, students recommended potential topics for future semesters such as the public opinion on regional job markets and skill demands.

Previous studies have used student responses in course evaluation questionnaires to assess the instructional design (Legner et al., 2013). All 14 students completed the standard anonymous course evaluation questionnaire at the end of the semester. The evaluation had two questions related to the overall course design. In response to "The course was well organized to promote my learning," the class average was 4.5 out of 5.0, where 1 indicates strongly disagree and 5 indicates strongly agree. On "I knew what was expected of me in this course," the class average was 4.2 out of 5.0.

The capstone project required extensive teamwork. In general, the groups worked well throughout the semester, but issues occasionally arose among members within a group. For example, there was strong disagreement among members of one group on their initial selection of the research topic. At the end of the semester, students completed confidential peer

evaluations of their teammates, and 50 of the 450 points in the final grade were based on the students' average evaluation scores. The class average of the peer evaluation was 48.4, with a standard deviation of 1.8.

6. DISCUSSION

6.1 Outcomes
The CUP framework and Kolb's experiential learning model helped guide the overall design of the capstone SMA project. We assessed the effectiveness of the project as a pedagogical tool through these theoretical models. From the perspective of the CUP framework, students successfully progressed through the pre-capture, capture, understand, and present phases and produced satisfactory results for each phase of the SMA project.

With respect to the steps in the experiential learning cycle, we also believe the project achieved the intended goal of stimulating student learning. First and foremost, students gained concrete experience through the capstone project. As the student comments in Appendix B suggest, the primary advantage was the opportunity to draw upon their prior coursework in business and technology to complete the research assignment and gain valuable insights to benefit a real community organization. The students also indicated that the holistic experience provided them with advantages in a competitive job market for BIA graduates.

From start to finish, students benefited from reflective observation by acting upon the constructive feedback they received from multiple stakeholders at different venues and subsequently improving their work. For example, feedback on their initial proposal from the community partner and instructors helped each group select and finalize their research topic. All three groups stated that, in preparing their final project presentations, they incorporated the comments and suggestions received from the audience and session judges during the Days of Discovery presentation.

Through activities such as writing assignments, online discussions, weekly oral reports, and preliminary and final project reports, students self-assessed and demonstrated their mastery of the concepts learned throughout the semester. Overall, we observed positive effects of abstract conceptualization as students progressed through the project.

While we could not observe active experimentation during the project, the students expressed their eagerness to apply what they learned in their future workplaces (see Appendix B). After graduation, some students also privately communicated to the instructors that they were able to apply some of the knowledge and skills that they gained through the capstone project in their current positions.

6.2 Challenges and Suggestions
Though the SMA research assignment described in this paper poses many benefits as a capstone project, there were also significant challenges for the instructors. Before embarking on this capstone project, most of the students had not completed a research project in its entirety. Therefore, each step of the process presented unique challenges that required close guidance from the instructors. For example, students were given the latitude to choose their own research question within the confines of the theme determined by the community partner and the instructors. However, instead of asking questions such as "what is the public sentiment toward dinning in restaurants

in NWI during the pandemic?", some groups were inclined to propose questions such as "do people spend less in restaurants during the pandemic?" or "how should governments help local restaurants during the pandemic?". The instructors needed to help those struggling define a research question by ensuring it aligned with the methodology and had an appropriate scope.

Unlike some SMA class assignments presented in the literature (e.g., Subramanian & Cote, 2018), we aimed to offer experiential learning opportunities in all three stages of the CUP framework. The student groups reported that the data collection and preprocessing (capture) stage demanded a substantial amount of time and effort. If an instructor wishes to devote more class time to learning and practicing different data analysis techniques (understand), it is recommended that they use a public corpus to reduce the amount of work at the capture stage. A public corpus such as TweetsKB would also offer longitudinal data to perform a time series analysis. Instructors could also design their projects based on other public data analytics tools such as Google Analytics. Lastly, while the CUP framework provided an easy-to-follow structure for our project, researchers have recently developed more elaborate models for SMA research that can guide the design of future capstone projects (El Haddaoui et al., 2018; Rohani & Shayaa, 2022). Well-known frameworks such as CRISP-DM (CRoss Industry Standard Process for Data Mining) and OSEMN (Obtain, Scrub, Explore, Model, and iNterpret) can also help instructors plan data analytics capstone projects.

Successful implementation of a capstone project requires faculty members to dedicate a significant amount of time and energy to teaching the course, and teaching in a team is a viable strategy to lessen the individual workload (Gupta & Wachter, 1998). The two faculty members teaching the capstone course in Spring 2021 split the responsibilities of preparing course materials and guiding the students. For example, while one instructor guided the student teams through data collection and preprocessing, the other faculty member taught sentiment analysis and data visualization. The department's accommodating teaching load policy allowed the faculty members to complement each other's skills and expertise and execute a project design that would otherwise be challenging for a single faculty member to complete.

Furthermore, teaching a capstone project in a highly technical field requires that instructors learn new technology and tools and be motivated to stay current (Gupta & Wachter, 1998; Parrish et al., 2009). Before offering the course, we conducted a research project on public sentiment using social media data on a topic of our interest. The experience deepened our understanding of SMA and allowed us to share first-hand experience as we guided the students through the project. During the spring 2021 semester, we used the standard and premium tiers of the Twitter API v1.1. Since then, Twitter API v2.0 has been released with significant improvements from the previous version, including a free tier for academic use. We would be happy to provide the sample R programs we developed for Spring 2021 upon request. However, we expect those samples to be rendered obsolete when Twitter deprecates the older version of the API. We plan to update or redevelop relevant class materials with the new version in the next iteration of the capstone project. Researchers can use sophisticated filtering features provided by the Twitter API during data capture in future projects, depending on their research topics. In addition, a combination of LDA and LIWC

analyses may yield more nuanced understandings, such as the sentiment breakdown of tweets especially related to service when dining in restaurants. Our BIA curriculum includes a course teaching introductory programming using both R and Python. Some students also expressed interest in learning more Python (see Appendix B). Therefore, we intend to investigate the potential to include Python or other third-party tools for future semesters.

Successful community engagement in the capstone project also calls for instructors to initiate, cultivate, and maintain good relationships with community partners. For example, instructors should invest time and effort in brainstorming potential projects with community partners and establishing overarching project goals. In future iterations of the capstone project, we anticipate involving additional community partners and identifying timely and relevant themes for the project each semester. Furthermore, we would want to use a questionnaire to collect valuable feedback from the community partners after the conclusion of the project. In sum, instructors should ensure the quality of student learning through their own growth, successful integration of the research process into learning practice, effective community engagement, and fostering student teamwork with structured reflection and assessment.

According to Kolb and Kolb (2009), each phase of the experiential learning cycle requires the learner to utilize a different capacity. As learners navigate the learning cycle in iterations, their learning capacity associated with each phase improves, hence forming a "spiral" of learning. To fully enable the experiential learning spiral, faculty members may need to overcome the limitations imposed by the linear structure of a semester-long project. They could accomplish this through a sequence of well-coordinated experiential learning projects spanning multiple courses within a BIA curriculum. This would give students the best opportunity to incrementally build their knowledge and skills through the learning spiral described by Kolb and Kolb (2009).

7. CONCLUSION

In recent years, many IS departments have created or transformed existing programs into BIA programs. A capstone project plays an essential role in BIA curricula. Educators have also recognized the advantages of social media text mining and analytics projects as a pedagogical tool in academic fields other than analytics, due to its positive impacts on student learning, student interest, and employability. We designed and implemented a capstone project to provide BIA students with a holistic learning experience. The positive outcomes we observed through the lens of Kolb's learning theory are consistent with the expected benefits. We hope that the capstone SMA project reported in this teaching tip can be adapted into a capstone or major class project for programs with similar needs.

8. ACKNOWLEDGMENTS

9. REFERENCES

Astin, A. W., Vogelgesang, L. J., Ikeda, E. K., & Yee, J. A. (2000). *How Service Learning Affects Students*. Los Angeles, CA: UCLA Higher Education Research Institute.

Baird, A., & Riggins, F. J. (2012). Planning and Sprinting: Use of a Hybrid Project Management Methodology Within a CIS Capstone Course. *Journal of Information Systems Education*, 23(3), 243-257.

Bauer, K. W., & Bennett, J. S. (2003). Alumni Perceptions Used to Assess Undergraduate Research Experience. *The Journal of Higher Education*, 74, 210-230.

Blei, D. M. (2012). Probabilistic Topic Models. *Communications of the ACM*, 55(4), 77-84.

Bian, J., Yoshigoe, K., Hicks, A., Yuan, J., He, Z., Xie, M., Guo, Y., Prosperi, M., Salloum, R., & Modave, F. (2016). Mining Twitter to Assess the Public Perception of the "Internet of Things." *PLoS ONE*, 11(7), article e0158450.

Boit, J., & El-Gayar, O. (2020). Topical Mining of Malaria Using Social Media: A Text Mining Approach. *Proceedings of the 53rd Hawaii International Conference on System Sciences* (pp. 3811-3820).

Corbin, M., Leavitt, C., Kettles, D., & Anderson, G. (2021). Experiential Learning Through a Week-Long Information Systems Case Study. *Proceedings of the 54th Hawaii International Conferences on System Sciences* (pp. 74-83).

Davis, C. H., & Comeau, J. (2004). Enterprise Integration in Business Education: Design and Outcomes of a Capstone ERP-based Undergraduate E-business Management Course. *Journal of Information Systems Education*, 15(3), 287-300.

Eagan, M. K., Jr., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). Making a Difference in Science Education: The Impact of Undergraduate Research Programs. *American Educational Research Journal*, 50(4), 683-713.

El Haddaoui, B., Chiheb, R., Faizi, R., & El Afia, A. (2018). Toward a Sentiment Analysis Framework for Social Media. *Proceedings of the International Conference on Learning and Optimization Algorithms: Theory and Applications* (pp. 1-6).

Ewing, M., Kim, C. M., Kinsky, E. S., Moore, S., & Freberg, K. (2018). Teaching Digital and Social Media Analytics: Exploring Best Practices and Future Implications for Public Relations Pedagogy. *Journal of Public Relations Education*, 4(2), 51-86.

Eyler, J., & Giles, D., Jr. (1999). *Where's the Learning in Service-Learning?* San Francisco, CA: Jossey-Bass.

Fan, W., & Gordon, M. D. (2014). The Power of Social Media Analytics. *Communications of the ACM*, 57(6), 74-81.

Felten, P., & Clayton, P. H. (2011). Service-Learning. *New Directions for Teaching and Learning*, 128, 75-84.

Gan, B. K. S., Ouh, E. L., & Lee, Y. Y. F. (2020). A Longitudinal Study of a Capstone Course. *AMCIS 2020 Proceedings*, 12.

Hauck, R. (2018). Creating Win-Win Opportunities: Integrating Community Engagement into the IS Classroom. *AMCIS 2018 Proceedings*, 83.

Henderson, A. (2016). Growing by Getting Their Hands Dirty: Meaningful Research Transforms Students. *The Journal of Economic Education*, 47(3), 241-257.

Hunter, A.-B., Laursen, S. L., & Seymour, E. (2007). Becoming a Scientist: The Role of Undergraduate Research in Students' Cognitive, Personal, and Professional Development. *Science Education*, 91(1), 36-74.

Goh, T. T., & Sun, P. C. (2015). Teaching Social Media Analytics: An Assessment Based on Natural Disaster Postings. *Journal of Information Systems Education*, 26(1), 27-36.

Gupta, J. N. D., & Wachter, R. M. (1998). A Capstone Course in the Information Systems Curriculum. *International Journal of Information Management*, 18(6), 427-441.

Hoxmeier, J., & Lenk, M. M. (2003). Service-Learning in Information Systems Courses: Community Projects that Make a Difference. *Journal of Information Systems Education*, 14(1), 91-100.

Kolb, D. A. (1981). Learning Styles and Disciplinary Differences. In A.W. Chickering (Ed.), *The Modern American College* (pp. 232-255). San Francisco, LA: Jossey-Bass.

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development* (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.

Kolb, A. Y., & Kolb, D. A. (2009). Experiential Learning Theory: A Dynamic, Holistic Approach to Management Learning, Education and Development. In S. J. Armstrong & C. V. Fukami (Eds.), *The SAGE Handbook of Management Learning, Education and Development* (pp. 42-68). SAGE Publications Ltd.

Kuh, G. (2008). *High-Impact Practices: What They Are, Who Has Access to Them, and Why They Matter.* Washington, DC: Association of American Colleges and Universities.

Legner, C., Estier, T., Avdiji, H., & Boillat, T. (2013). Designing Capstone Courses in Management Education: Knowledge Activation and Integration Using an ERP-based Simulation Game. *ICIS 2013 Proceedings*, 8.

Lending, D., & Vician, C. (2012). Writing IS Teaching Tips: Guidelines for JISE Submission. *Journal of Information Systems Education*, 23(1), 11-18.

Lopatto, D. (2004). Survey of Undergraduate Research Experiences (SURE): First Findings. *Cell Biology Education*, 3, 270-277.

Lundgaard, D., Razmerita, L., & Tan, C.-W. (2018). Emergent Collaboration on Twitter: A Case Study of the #BlackLivesMatter Movement. *Proceedings of the 51st Hawaii International Conference on System Sciences* (pp. 2193-2202).

MarketsandMarkets. (2021). *Social Media Analytics Market by Component, Analytics Type, Application (Sales and Marketing Management, and Competitive Intelligence), Deployment Mode, Organization Size, Vertical, and Region - Global Forecast to 2026.* https://www.marketsandmarkets.com/Market-Reports/social-media-analytics-market-96768946.html

Maze, J. (2020). *Consumers Likely to Cut Back on Restaurants in A Coronavirus Pandemic.* https://www.restaurantbusinessonline.com/financing/consumers-likely-cut-back-restaurants-coronavirus-pandemic

Moore, D. T. (2010). Forms and Issues in Experiential Learning. In D. M. Qualters (Ed.), *New Directions for Teaching and Learning* (pp. 3-13). New York City, NY: Wiley.

Patten, K., & Keane, L. (2009). Experiential Service Learning Using Real Client Projects in a Capstone IT Course. *AMCIS 2009 Proceedings*, 773.

Parrish, J., Bailey, J., & Jensen, B. (2009). The Imagine Cup Software Development Invitational: Implications for Use in the IS Capstone Course. *AMCIS 2009 Proceedings*, 453.

Redhu, S., Srivastava, S., Bansal, B., & Gupta, G. (2018). Sentiment Analysis Using Text Mining: A Review. *International Journal on Data Science and Technology*, 4(2), 49-53.

Restaurant Business. (2020). *Timeline: The Impact of Coronavirus on Restaurants.* https://www.restaurantbusinessonline.com/operations/timeline-impact-coronavirus-restaurants

Rohani, V. A., & Shayaa, S. (2022). Toward a Comprehensive Framework of Social Media Analytics. *Big Data and Blockchain for Service Operations Management* (pp. 191-208). Springer, Cham.

Salehan, M., & Kim, D. J. (2016). Predicting the Performance of Online Consumer Reviews: A Sentiment Mining Approach to Big Data Analytics. *Decision Support Systems*, 81, 30-40.

Schaffer, M. A. & Peterson. S. (1998). Service Learning as a Strategy for Teaching Undergraduate Research. *Journal of Experiential Education*, 21(3), 154-161.

Sharma, A., Noone, B., Lee, S., Yu, C., Lin, M., Jung, I., & Quadri-Felliti, D. (2020). *Restaurants and Foodservice Businesses during COVID-19.* https://covid19.ssri.psu.edu/articles/restaurants-and-foodservice-businesses-during-covid-19

Similarweb. (2022). *Top Websites Ranking for All Categories in the World.* https://www.similarweb.com/top-websites/

Statista.com. (2022). *Most Popular Social Networks Worldwide as of January 2022, Ranked by Number of Monthly Active Users.* https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/

Steiger, D. M. (2009). Teaching Case: Enhancing Knowledge Integration: An Information System Capstone Project. *Journal of Information Systems Education*, 20(1), 17-24.

Steingass, A., Perales, A., Lopez, E., Ye, C., & Zhao, L. (2021). Effects of COVID-19 on Public Sentiments toward Online Shopping in the Northwest Indiana Community: Evidence from Twitter. *Proceedings of the Institute for Global Business Research Conference*, 5(3), 58.

Subba, R., & Bui, T. (2017). Online Convergence Behavior, Social Media Communications, and Crisis Response: An Empirical Study of the 2015 Nepal Earthquake Police Twitter. *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 284-293).

Subramanian, R., & Cote, D. (2018). Using SAS™ Software to Enhance Pedagogy for Text Mining and Sentiment Analysis Using Social Media (Twitter™) Data. *Journal of International Technology and Information Management*, 27(2), 73-98.

Tausczik, Y., & Pennebaker. J. (2010). The Psychological Meaning of Words: LIWC and Computerized Text Analysis Methods. *Journal of Language and Social Psychology*, 29, 24-54.

Wang, W., Hernandez, I., Newman, D. A., He, J., & Bian, J. (2016). Twitter Analysis: Studying US Weekly Trends in

Work Stress and Emotion. *Applied Psychology*, 65(2), 355-378.

Wymbs, C. (2016). Managing the Innovation Process: Infusing Data Analytics into the Undergraduate Business Curriculum. *Journal of Information Systems Education*, 27(1), 61-74.

Yang, Y., Liu, H., & Chen, X. (2020). COVID-19 and Restaurant Demand: Early Effects of the Pandemic and Stay-at-Home Orders. *International Journal of Contemporary Hospitality Management*, 32(12), 3809-3834.

Ye, C., & Zhao, L. (2021). Public Perceptions of Facebook's Libra Digital Currency Initiative: Text Mining on Twitter. *Proceedings of the 54th Hawaii International Conference on System Sciences* (pp. 5627-5635).

AUTHOR BIOGRAPHIES

Chen Ye is an associate professor of management information systems in the College of Business at Purdue University Northwest. His research areas include technology user behavior, business impact of technology innovations, blockchain technology, and technologies in higher education. His research has been published in the *Communications of the ACM*, *Communications of the AIS*, *Decision Sciences Journal of Innovative Education*, *Decision Support Systems*, *Journal of the Association for Information Science and Technology*, *Journal of Information Systems Education*, and other journals.

Lin Zhao is a professor of information systems and Senior Associate Dean of the David B. O'Maley College of Business at Embry-Riddle Aeronautical University. She holds a B.E. in systems engineering and a M.Ec. in quantitative economics and management from Tianjin University, China. She earned a Ph.D. in Management with specialization in Information Systems from Weatherhead School of Management at Case Western Reserve University. Her present research focuses on e-Learning and social media analytics, and her recent peer-reviewed publications appear in *Decision Sciences Journal of Innovative Education* and *HICSS Conference Proceedings*.

APPENDICES

Appendix A. Course Schedule

Phase	Week	Meeting Topic	Assignments
Pre-Capture	1	Introduction	
	2	Meeting with the community partner to discuss project topics	One page reflection; Group formation.
	3	Q&A	Verbal progress report; Discussion #1
	4	Q&A	Verbal progress report; Project proposal
Capture	5	Data Retrieval and Data Pre-processing	Verbal progress report
	6	Q&A	Verbal progress report
	7	Q&A	Verbal progress report
Understand	8	Sentiment Analysis (LIWC)	Verbal progress report
	9	Data Analysis (Latent Topical Modeling)	Verbal progress report
	11	Q&A	Verbal progress report; Preliminary Project Report
	12	Q&A	Verbal progress report; PPT slides or poster
Present	13	Presentation at the Days of Discovery	Verbal progress report
	14	Q&A	Verbal progress report
	15	Presentation to the community partner	PPT slides
	16		Discussion #2 Final Project Report

Appendix B. Student Reflection Responses

Please discuss the relevance of your project to your coursework and your academic interests
This class has taken pieces of past classes and combined them into one useful project to showcase my abilities. I very much enjoyed the exploration of Twitter API, gathering data, analyzing the collected data, and making decisions based on those analysis.
Overall, this course has been a great experience since we were able to apply our knowledge to a real-world business problem. I gained valuable experience by learning new analytic techniques firsthand and also being able to practically apply knowledge learned from previous classes. Some of the data techniques I have learned were extracting data from social media such as Twitter and being able to analyze the sentiment of it using LIWC. Having been able to perform this research project has not only improved the analytical side of things but also challenged us to think of ways to best communicate the results and think about solutions to the impacted stakeholders.
It is exactly what a senior level course should be like. We learned everything about data and how to use it in previous years and in this final semester, we were given autonomy to use our knowledge while solving real world problems. Great Class and thank you for the semester!
My group and I had a lot of fun and enjoyment while doing this project, as you can probably tell we all learned a lot! This project was the highlight of my PNW career and my resume is much stronger because of it.
While working through this project, we collected all previous knowledge and skills we developed over our four years at PNW. It was actually really nice to see that we learned how to research, collect, manipulate and analyze data and be able to apply analytics to real world situations. I believe this exact project would be ideal for future senior courses for future students.

Please discuss the relevance of your project to your professional goals and your professional future
The coursework we worked through this semester provided me with experience that I believe I will be able to apply to life following graduation. It allowed me to conduct some further research than I normally would, which in return gave me a greater look into the real world amid the pandemic. I hope to expand on these experiences in the future and look forward to going above and beyond in the workplace.
Social media analytics is becoming a very relevant field in the job market and having worked on this topic is very helpful for graduates to get a job. I really liked the aspect that we were able to work on a real-life project that was important to the community. Being able to analyze real data is definitely something I recommend for future classes to stay.
Our project is very relevant to my professional future. In my future position as a financial analyst, I will have to use R like we did in the project on a daily basis. I would also recommend learning and using python in the future for this class.
This class in particular provided me with not only essential knowledge but the tools that will be very beneficial towards my future as a professional. Learning how to analyze and extract huge amounts of data from big database and then forming a presentation/report gave me a lot of useful experience.
The relevance of this project and class to professional future are very high. This project has shown me how to gather social opinion on a specific topic that may be relevant to a current issue. Future employers may ask me to gather such data to help in business decisions. Since my major is business analytics, gathering data and being able to explain the impact and outcomes of such data is very relevant. Learning how to clean data is another useful tool to be able to provide to future employers. Though I am not searching for a position in coding systems or building databases, being able to find tools that will help me expand systems and databases already in use is something I can now say I have done. I also believe that presenting such a project to future employers shows my abilities to make conclusions that can help them for future planning.
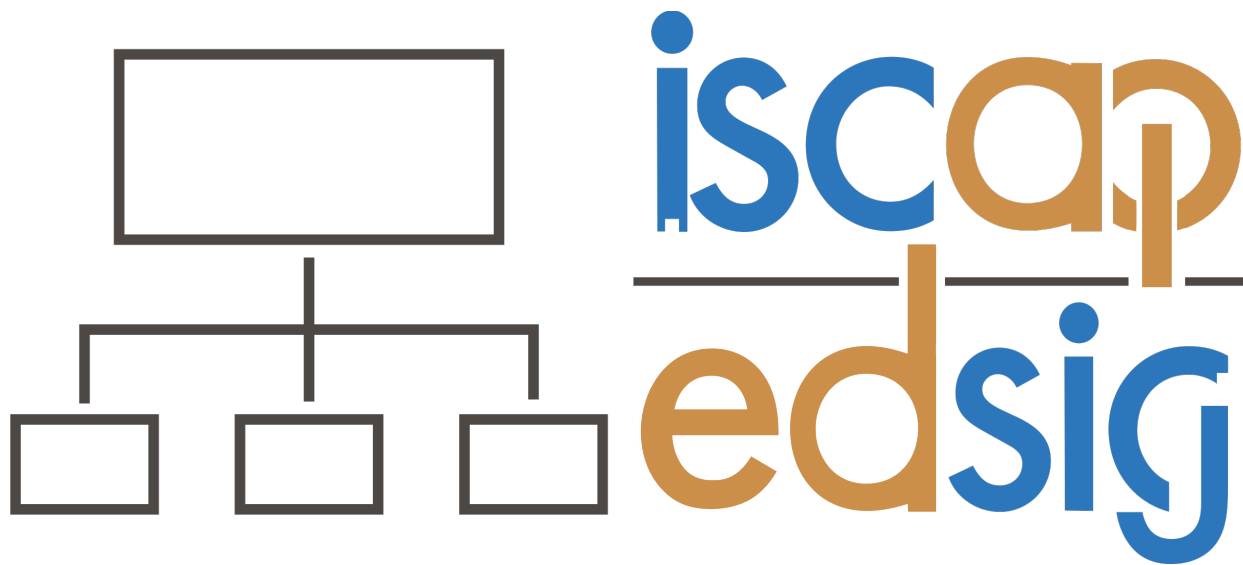
Information Systems & Computing Academic Professionals

Education Special Interest Group

STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the *Journal of Information Systems Education* have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.